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ABSTRACTS

of recent published material on
Soil and Water Conservation

Number 31



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Charles B. Crook, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland, 20705

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WATERSHED ENGINEERING

Watershed Development

Watershed Planning Division. MULTIPLE-PURPOSE WATERSHED PROJECTS UNDER PUBLIC LAW 566. U.S. Dept. Agr., Soil Conserv. Serv. PA-575, 13 pp. 1963.

Experience in hundreds of localities demonstrates that multiple-purpose small watershed projects are an effective means for rural and urban communities to deal with land use and water problems.

Since 1954, when the Watershed Protection and Flood Prevention Act (Public Law 566) was enacted, many rural and urban communities have shown that they can halt unchecked soil erosion and excessive water runoff on rural land, stop destructive floods, improve drainage conditions on land in agricultural production, provide for more efficient irrigation, supply water for growing municipal needs, attract new industries, enhance fish and wildlife resources, and provide developments for recreation.

Small watershed projects have come to mean protecting, managing, improving, and developing the water and related land resources of a watershed up to 250,000 acres in size through a project-type undertaking.

Facts about multiple-purpose watershed projects--how they get started; how they are constructed, financed, operated, and maintained; what the Federal Government does; and what the local people do were given.

SCS, USDA, Inform. Div., Washington, D.C. 20250

Simms, H. THE YEARS AHEAD: FUTURE OF SMALL WATERSHED PROGRAM. Land and Water Contract. 5(1): 12-14. 1963.

In 9 years the watershed program has grown from a legislative idea into a \$60 million program.

Designed primarily for flood prevention, watershed projects have developed a host of side benefits that create new economic opportunities in the communities they protect. Cities have been provided with a new water supply, industries lured into an area, and recreation areas developed for outdoor fun, all because of watershed projects which were built mainly for protection against floods.

Before this decade ends, the Soil Conservation Service hopes to help local organizations protect and develop some 2,000 watersheds. Such a program would benefit 13,500,000 people living in the watershed areas and would reduce the Nation's flood damage by \$129 million a year.

SCS, USDA, Washington, D.C. 20250

Hickok, R.B. HYDROLOGY RESEARCH NEEDS FOR UPSTREAM FLOOD PREVENTION. Internatl. Comn. on Irrig. and Drain. 5th Cong. Quest. 18: 75-88. 1963.

Eight thousand three hundred small watersheds, up to 400 square miles in size, comprising half the land area of the U.S.A., need flood protection and related land and water resources development. Their protection and development may be authorized for joint projects of local, State, and Federal agencies under Public Law-566. Planning and designing of

such upstream watershed protection and development projects are the responsibility of the U.S. Department of Agriculture. The Department's Agricultural Research Service conducts research in specific support of this program.

Protection from flood and associated sediment damage is the dominant problem. However, many of these watersheds need multipurpose projects for their best protection and utilization. Additional needs involve domestic and irrigation water supplies, drainage, recreation, fish and wildlife protection, and low-flow regulation for pollution abatement. An estimated 4,000 of these watersheds need drainage improvement, and 2,600 need irrigation facilities.

Planning and design have been accomplished for approximately 8 percent of the upstream watersheds needing PL-566 projects. Those remaining will involve increasingly complex problems.

Much of the information on which hydrologic designs must now be developed has come from small-plot and small-watershed experiments designed for other purposes. Additional information is needed for better understanding of storm runoff generative processes. Data are needed from numerous types of unit-source watersheds representing various combinations of soil-plant and geologic influences, as these interact to determine the flood runoff characteristics of hydrologically significant watershed sub-areas.

There is a major need for better information on time-depth-area characteristics of convectional rainstorms, as these vary with geographic region and local influences.

Streamflow hydraulics research is needed for development of more feasible and precise methods of routing the flood runoff from headwaters areas, through complex channel systems, for synthesis of downstream flood hydrographs. Limited research on this is currently underway.

Basic hydrologic information is needed for planning and designing of upstream flood prevention, related irrigation drainage, and other improvement on small watersheds in the United States. These needs are engaging the concerted efforts of hydrologists, meteorologists, hydraulicists, geologists, and plant and soil scientists in comprehensive watershed research. Much more such research is needed.

SWCRD, ARS, USDA, Riverside, Calif. 92506

Hydrology

Revelle, R. WATER. Sci. American 209(3): 93-100, 102, 104, 106, 108. 1963.

A discussion of the water needs and use throughout the world was given.

No address given.

Myers, L. E. WATER CONSERVATION: A RESEARCH CHALLENGE. J. Soil and Water Conserv. 18: 31-34. 1963.

The national water supply problem is composed of many highly varied local water supply problems. Just as there are many different problems there will be many different solutions. Development of new water supplies through construction of reservoirs, stream diversions, and ground water pumping systems is rapidly becoming so expensive and difficult that alternate means must be considered. Some planners are apparently delaying long range action in the hope that all problems will be solved by pending scientific and engineering miracles.

Water pollution control is one major facet of the water supply complex that is now receiving considerable amount of attention and support. Equal attention should be given to the application of conservation principles in the development and management of municipal, agricultural, industrial, and recreational water supplies. Application of these principles of water conservation, including the conservation of rainfall and snowmelt, is essential if the Nation's water supply problems are to be solved.

U.S. Water Conservation Lab., SWCRD, ARS, USDA, Tempe, Ariz. 85281

van't Woudt, B. D., and Nelson, R. E. HYDROLOGY OF THE ALAKAI SWAMP, KAUAI, HAWAII. Hawaii Agr. Expt. Sta. B. 132, 30 pp. 1963.

An analysis of aerial photographs in combination with field observations revealed that the Alakai swamp consists of approximately: 59.5 percent dissected land; 29 percent flat to moderately sloping land; and 11.5 percent treeless area.

Of the treeless area, 8 percent is a "mountain barren" near the summit of Waialeale, and the other 3.5 percent is typical swamp.

Eighty-eight percent of the area is covered by ohia, ranging from open forest on well-drained sites to dense swamp forest.

Subsoil analysis showed low permeability, explaining peat formation on approximately 3,700 acres out of an assumed 20-square-mile extent of the Alakai swamp.

The Alakai swamp is continuously moisture-saturated, the result of approximately 250 inches of rainfall well distributed throughout the year. The swamp acts as a collecting and overflow basin during most of the time. This explains the close relationship between rainfall and streamflow in the area.

The volume of the peat deposit was estimated at 3,700 acre-feet, from which an estimated 1,100 acre-feet of water or less is released during dry spells. This, added to an estimated 100 acre-feet per day release from subsurface storage above 3,000 feet elevation via springs, accounts for a small base-flow in the Waimea and Makaweli Rivers during dry spells. These dry spells normally do not exceed 1 or 2 weeks per year.

Hawaii Agr. Expt. Sta., U. Hawaii, Honolulu, Hawaii.

Hart, G. SNOW AND FROST CONDITIONS IN NEW HAMPSHIRE, UNDER HARDWOODS AND PINES AND IN THE OPEN. J. Forestry 61: 287-289. 1963.

White pine and red pine plantations were comparable in snow depth, but a hardwood stand had a snow depth similar to that in an open field. Differences were attributed mainly to canopy density. Order of snow disappearance was: (1) Open field; (2) hardwoods; (3) red pine; and (4) white pine. Melt rates were 0.10, 0.05, and 0.04 inches per day for hardwoods, white pine, and red pine, respectively.

In 1960, the open field was extensively frozen by December 22, about 3 weeks before concrete frost was found to any extent in the forested plots. Frost was most extensive on January 12 and 22, with maximum occurrences of 39 percent for hardwoods and red pine, 93 percent for white pine, and 100 percent for the open field. By February 7 open-field frost occurrences were down to 21 percent (frost disappeared by February 16) and frost was virtually absent in the forested plots; at this time snow depth was about 20 inches. Frost tended to persist sporadically under white pine for a longer time than under red pine.

Yearly fluctuations in temperature and snow depth produced large variations in frost occurrence, particularly under conifers. Uniformly shallow frost--1.6 to 1.8 inches average--was found in all four cover types.

Laconia Res. Cent., Northeastern Forest Expt. Sta., FS, USDA, Laconia, N.H.

Ogrosky, H. O. EFFECTS OF CONSERVATION ON WATER YIELD. J. Soil and Water Conserv. 18: 11-13. 1963.

Conservation programs have demonstrated their beneficial effects on the quality and time distribution of water yield. But the effects of such programs on water yields from entire river basins is probably not significant when compared to other changes taking place in major river basins.

The elimination of waste in water use is probably the greatest contribution that can be made to solve the water problem at the present time. Agriculture, as a major user of water, has an important role to play in this task.

SCS, USDA, Washington, D.C. 20250.

Geology

Schumm, S. A. SINUOSITY OF ALLUVIAL RIVERS ON THE GREAT PLAINS. Geol. Soc. Amer. B. 74: 1089-1100. 1963.

Data on the morphologic and sediment characteristics of stable alluvial rivers of the Great Plains were collected at 50 cross sections. The channel patterns of these rivers were classified into five types: Tortuous; irregular; regular; transitional; and straight. Because no clear demarcation existed between each of the types, the pattern of the rivers was described by sinuosity, a ratio of channel length to valley length.

Sinuuous streams were characterized by a low width-depth ratio (f), a high percentage of silt-clay in the perimeter of the channel (m), a high percentage of silt-clay in the banks (although the banks of straight channels may also contain large amounts of silt-clay), and a lower gradient than straight channels having the same mean discharge. Discharge itself did not appear to affect the sinuosity of streams.

Another distinction between straight and sinuous streams was in the proportions of the components of total sediment load. In a wide, shallow channel, much of the sediment transported was bed-material load. In a narrow, deep channel, most of the sediment transported was wash load.

On the Great Plains, both straight and sinuous streams may flow on the surface of alluvial valley fills at about the same valley slope. The departure of a stream from a straight course down the alluvial valley results from changes in both the caliber of the sediment load and in the relative proportions of bed-material load and wash load during the post-Pleistocene alluviation of these valleys. When during this alluviation the proportion of wash load increased, most probably by a decrease in bed-material load, the stream adjusted itself by decreasing its gradient through the development of a sinuous course. Recent changes in stream sinuosity in response to changes in the proportions of bed load and suspended load supported this hypothesis.

U.S. Geol. Survey, U.S. Dept. Int., Denver, Colo.

Guy, H. P., Jackson, N. E., Jarvis, K., Johnson, C. J., Miller, C. R., and Steiner, W. W. A PROGRAM FOR SEDIMENT CONTROL IN THE WASHINGTON METROPOLITAN REGION. Interstate Comm. on the River Basin. Tech. B. 1963-1, 48 pp. 1963.

It was estimated that in the years ahead sediment removal in the Potomac Estuary, for navigation purposes alone, will cost at least \$1.5 million annually.

Increasing populations and resulting demands for high quality water for all uses make it imperative that corrective measures be taken without delay. Cooperation and active participation by all jurisdictions in the Metropolitan region will be essential. Sediment abatement measures are urgent, economically justified, and long overdue.

Until the advent of mass development and the employment of heavy earth-moving equipment, urban and suburban soils were relatively undisturbed, and the hazards of erosion and sediment pollution were considered rural problems. In the Washington Metropolitan Area, one of the fastest-growing areas in the Nation, rates of erosion and sediment production far exceeds those in rural areas. While the consequences are numerous in the Washington area, the overwhelming concern is the effect on the quality of the water in the Potomac River.

Almost without exception excessive silt is harmful to the beneficial uses of water. In purification for domestic and industrial uses, costs of clarification generally exceed all other costs. Silt smothers and otherwise inhibits aquatic life and reduces the recreation potential.

Erosion of the soil and consequent sediment pollution are caused by rainfall and uncontrolled run-off of water. Basically two means are available to effect control: (1) Vegetation, which blankets the soil and prevents the erosive forces of the water from reaching the soil particles; and (2) mechanical structures which dissipate the forces of the water. Many of the practices based on these two means, which were developed to combat rural erosion, can be used under urban conditions.

Soil Conservation Districts provide the leadership and source of assistance to the rural land owner who has a long-term interest in protecting his land against the ravages of erosion. The district procedure has been successful. Unfortunately, a similar situation does not exist in urban areas.

Three principal sources of sediment exist in urban areas: (1) Commercial and residential development construction; (2) highway and other public construction projects; and (3) public parks and recreation areas.

In the first two instances high erosion rates occur during the construction period. One of the least costly, and most effective, means of reducing erosion is a shortening of the construction time period during which the raw soil is exposed. In all three instances, the ideal is the control of run-off water flowing over the land.

The committee recommended that: Each jurisdiction study this report with an open mind; that responsible officials consult with the erosion control specialists; and that a program be developed for that jurisdiction which will, along with other jurisdictions, amount to an intelligent region-wide effort to reduce erosion and sediment pollution to a minimum.

Interstate Comm. Potomac River Comm., 203 Transportation Bldg., Washington, D.C. 20006

Ursic, S. J., and Dendy, F. E. SEDIMENT YIELDS FROM SMALL WATERSHEDS UNDER VARIOUS LAND USES AND FOREST COVERS. Second Federal Interagency Conf. on Sedimentation. Jan. 28 to Feb. 1, 1963 at Jackson, Miss. 9 pp. 1963.

Data from small watersheds in the hilly uplands of north Mississippi showed large variations in annual runoff and sediment production attributable to land use and cover types.

Runoff decreased in the order: Corn and pasture > abandoned fields and depleted hardwoods > pine plantations. Annual sediment yields and average concentrations of sediment per unit of runoff decreased in the order: Corn > pasture > abandoned fields and depleted hardwoods > pine plantations and mature pine-hardwoods. These progressions represent discrete populations of erosions potential.

Runoff was greater from watersheds with loessial soils than from those with both loess and Coastal Plain soils, but the effect of soil on sediment yields was not consistent for all covers.

Extremes in annual sediment production ranged from 43 tons per acre from a cultivated watershed to a few pounds per acre from pine plantations. Sediment yields from abandoned fields with a dense cover of native grass and from forest covers did not exceed 0.5 ton per acre annually. Yields from gullies in the same locality were reported from 84 to 400 tons per acre.

The studies are yielding data which should eventually allow prediction of sediment production from permanent covers. They suggest opportunities for reducing runoff and sediment by changing land use and cover types.

Establishing pine on actively eroding abandoned fields has in two decades reduced sedimentation to amounts probably not in excess of the geologic norm for undisturbed climax forests in this area.

Southern Forest Expt. Sta., FS, USDA, Oxford, Miss.

Wark, J. W., and Keller, F. J. PRELIMINARY STUDY OF SEDIMENT SOURCES AND TRANSPORT IN THE POTOMAC RIVER BASIN. Interstate Comn. Potomac River Basin, Tech. B. 1963-11, 28 pp. 1963.

The findings of a 2-year sediment study made by the U.S. Geological Survey in cooperation with the Interstate Commission on the Potomac River Basin were given. The magnitude of sediment loads of streams in the Basin and the sources of sediment were determined. Environmental factors affecting sediment yield were also studied.

Sediment discharge measurements were made during periods of high run-off at 40 locations, and 2 daily sediment stations were operated. For each location, the average annual sediment load was computed using the sediment transport curve-flow duration method.

Computed average annual sediment discharge varied from 21 to 2,300 tons per square mile and were attributed chiefly to variations in land use. Drainage basins with a high percentage of forest cover had low sediment yields. Areas undergoing urbanization in the Washington, D.C., area had the highest yields. The estimated average annual sediment load of the Potomac River was about 2.5 million tons. Most of the annual sediment load of streams in the Basin was discharged in a few days each year. Future changes in land use and the construction of large reservoirs in the Basin should have an effect on sediment loads.

Interstate Comn. Potomac River Basin, 203 Transportation Bldg., Washington, D.C. 20006

Heinemann, H. G. USING THE GAMMA PROBE TO DETERMINE THE VOLUME-WEIGHT OF RESERVOIR SEDIMENT. Internatl. Assoc. Sci. Hydrol. Comn. Land Erosion. Proc. 59: 410-423. 1963.

Determining the volume-weight of deposited sediment is a necessary part of a reservoir sedimentation survey. This unit of measurement is essential for converting data on

accumulated sediment in a reservoir to information on sediment yield from the watershed, and for applying knowledge gained from surveys to the solution of other sedimentation problems.

The gamma probe is a practical instrument for obtaining the volume-weight of reservoir sediment. It operates on the principle that gamma rays from a Radium-226 source are scattered by electrons present in water and sediment. The amount of rays reflected back from an ellipsoid of about 1 cubic foot to Geiger-Muller detectors is inversely proportional to the wet volume-weight of the sediment in place. The dry volume-weight can be determined by adjusting for the absolute specific gravity of the sedimentary materials and using a calibration curve.

Detailed studies of the calibration and other basic phenomena indicated that there were several advantages and a few limitations in using the gamma probe. Less field and laboratory work was required for surveys, and approximate volume-weights of a wide range were determined in the field. The probe was used successfully in thick sediment deposits in deep water. The capital investment is relatively high (about \$4,000) and the conversion to dry volume-weight needs standardization and improvement.

Direct comparisons between the results obtained with the gamma probe and volumetric sampling equipment cannot be made, but the comparison that can be made appears to be consistent. Additional studies are under way to improve the probe itself and this method of determining the volume-weight of reservoir sediment.

SWCRD, ARS, USDA, Lincoln, Nebr. 65803

Engineering Design

Maughan, W. D., and Kawano, R. Y. PROJECT YIELDS BY A PROBABILITY METHOD.
J. Hydraul. Div., ASCE 89 (HY 3): 41-60. May 1963.

Whether estimating future available water supplies, safe yields from proposed reservoirs, or the firm energy that can be expected from hydroelectric power projects under study, engineers have generally used for bases past recorded or estimated runoff, or both, in exactly the same historical sequence. This method has many limitations.

With an electronic computer, it is possible to make a large number of hypothetical runoff sequence studies in a short time. These can be analyzed to give results in terms of the occurrence of any supply, yield, or firm energy within any contemplated repayment period.

A simplified probability method for estimating firm yield and generation was presented, together with basic assumptions presumed to be of general applicability to reservoir yield studies. The method involves: (1) The selection of a study period; (2) the use of electronic digital computers to establish hypothetical runoff sequences, to perform the previously laborious statistical computations, and to plot graphs of cumulative departures from the mean for each sequence; (3) manual graphical analyses of the computer results; and (4) compilation of the results of the graphical analyses into an easily unstandable form.

This method applied to Glen Canyon Reservoir resulted in a 50 percent probability that its safe yield, during a 50-yr. repayment period, would be at least 7.8 million acre-ft. per yr. if the reservoir were at minimum power pool at the beginning; it would be at least 8.4 million acre-ft. per yr., if the reservoir were full at the beginning of repayment.

Colo. River Bd. of Calif., Los Angeles, Calif.

Trelease, F. J., and Bittinger, M. W. MECHANICS OF A MATHEMATICAL GROUND-WATER MODEL. J. Irrig. and Drain. Div., ASCE 89 (IR 1): 51-62. March 1963.

A mathematical model was devised to study a problem in the Fountain Creek Valley, Col. A digital computer was used to compute drawdowns in 10 observation wells at 60-day intervals over a 3-yr. period for various aquifer and boundary conditions. It was concluded that:

1. The mathematical model and digital computer, together with rather severe idealizations of boundaries, hydraulic characteristics, and pumping patterns, yielded satisfactory results for describing the performance of an aquifer.
2. Computer programs of a general nature may be written to apply to any similar aquifer by changing the input data.
3. The amount of computer time may be unduly increased by requiring accuracy greater than the input data and assumptions justify. Considerable thought should be given to the degree of computational accuracy realistically needed.
4. Refinements of assumed conditions can be made and repeated calculations quickly run in order to obtain a better fit with measured data.

Jr. Author, Colo. State U., Fort Collins, Colo.

Amorocho, J. MEASURES OF THE LINEARITY OF HYDROLOGIC SYSTEMS. J. Geophysical Res. 68: 2237-2249. 1963.

The nonlinear response of watersheds under rainfall may be represented by means of functional series incorporating mathematical operations equivalent to the physical actions of these systems. This functional representation involves the consideration of higher powers of the elements of the inflow, and it can lead to a more accurate prediction of the forms and magnitudes of flood events than is possible by the linear approximation involved in such methods as the unit hydrograph procedure.

The theory of the functional series representation of hydrologic systems was discussed, and measures of the linearity of these systems were developed which aided in interpreting some of the errors inherent in the unit hydrograph concept. The applicability of the functional analysis was confirmed in studies of laboratory catchments. Explanations for some of the characteristics of the behavior of natural watersheds were suggested.

U. Calif., Davis, Calif.

Abu-Zied, M. A., and Scott, V. H. NONSTEADY FLOW FOR WELLS WITH DECREASING DISCHARGE. J. Hydraul. Div., ASCE 89 (HY 3): 119-132. May 1963.

A solution for nonsteady flow to a well completely penetrating a homogeneous elastic artesian aquifer was developed. Because a continuous lowering of the water level inside wells normally corresponds to a decreasing pumping rate, it was desirable to introduce this factor into the flow problem. Consideration was given to a discharge-time exponential function that approached an approximately constant pumping rate. The solution for the drawdown was expressed in terms of the discharge and aquifer characteristics. Discharge parameters were determined for pumping-rate test data. A graphical solution was developed for the determination of the aquifer characteristics. This graphical solution required the numerical computation and the tabulation of a "variable well function" that

appears in the drawdown expression. Generally, the solution developed provided greater accuracy in the calculation of the aquifer characteristics and drawdown, especially for short-period pumping tests.

U. Calif., Davis, Calif.

Ground Water Recharge

Bouwer, H. THE FLOW SYSTEM BELOW A WATER SPREADING BASIN. Internatl. Comn. Irrig. and Drain., 5th Cong., Quest. 18; 89-106. 1963.

The flow system between a recharge basin and the lower mound may consist of a number of perched mounds and percolation zones. The flow conditions governing formation and recession of individual mounds can be of considerable complexity. With a resistance network analog, non-uniformities and complexities in soil and boundary conditions can be taken into account. Solutions may be obtained regarding rise, fall, or equilibrium state of mounds above original water tables and perching layers for two-dimensional or axially symmetrical flow systems.

Of the various mounds that may be formed below a recharge system, the upper and lower mounds are the most important. The upper mound can affect the recharge rate from the basin, whereas the lower mound determines the storage and recovery of the recharge water. Due to the high moisture content in the zone of percolation below the recharge basin, mounds can be expected to rise rapidly to a semi-equilibrium condition when the wetting front reaches the water table or perching layer, after which lower rates of rise tend to occur. Graphs were presented to estimate the height of this semi-equilibrium position and the time in which this position is reached, for mounds above original water tables and two-dimensional systems.

The effect of the upper mound on the recharge rate from the basin was considered in relation to the hydraulic conductivity of the bottom of the basin, which has a tendency to decline with prolonged recharge. It was shown that a rising mound can increase, decrease, or not affect at all, the recharge rate from the basin, depending on the hydraulic conductivity of the bottom material compared to that of the rest of the soil. The role of the unsaturated conductivity characteristics of the soil below slowly permeable bottom material in the relationship between recharge rate and water table height was discussed. The effect of water depth in the basin on recharge was also dependent upon water table height and hydraulic conductivity of bottom material. A numerical example was presented to illustrate the various relationships.

The applicability of theoretical analyses to individual recharge installations depends on the adequacy with which pertinent field data can be evaluated and on the accuracy with which secondary effects such as air entrapment, reactions between the recharge "water" and the soil complex, etc., can be estimated. Experimental recharge facilities may be installed for in-place investigations of conditions governing recharge. Examples were presented of this type of information.

SWCRD, ARS, USDA, Tempe, Ariz. 85281

WATER MANAGEMENT

Irrigation

Kruse, G. E. THE HYDRAULICS OF SMALL, ROUGH IRRIGATION CHANNELS. Internatl. Comn. on Irrig. and Drain., 5th Cong. Quest. 16: 161-176. 1963.

The resistance to flow in small soil channels, similar to irrigation furrows and borders, was studied in the laboratory. Primary factors affecting resistance were degree of turbulence, boundary roughness, and channel shape. Each channel was formed with a different roughness and was stabilized with a chemical spray to prevent erosion by the flow during a series of experimental runs.

To determine the degree of turbulence, Reynolds numbers were computed and the relations of the resistance coefficients to the Reynolds numbers were compared with the classical relations for laminar and turbulent flow. Also, dye streams injected into the flow were observed. At some of the very small discharges, flows were laminar. The critical Reynolds number, VR/v , was found to vary from 400 to 700 depending on the degree of roughness of the boundary.

The experimental data for turbulent flows were analyzed in terms of a logarithmic-type resistance equation. Values of a resistance parameter were calculated for each channel on the basis of the experimental data. The resistance parameter for each channel was then expressed empirically in terms of measured dimensions of the boundary roughness. The resistance parameter correlated fairly well with the standard deviation of the bed elevation measurements. Roughness shape and spacing also affected the resistance to flow in a channel, but could not be measured with sufficient accuracy to be useful in predicting flow resistance. From the relationship of the resistance parameter and the measured roughness height, the effect of channel shape on resistance was negligible.

Knowledge of the resistance to flow in borders or furrows is necessary in order to predict rate of advance of irrigation streams. Information on rate of advance aids in designing systems for maximum efficiency.

SWCRD, ARS, USDA, Fort Collins, Colo. 80521

Pair, C. H. EFFECTS OF IRRIGATION METHODS AND SYSTEM MANAGEMENT ON WATER APPLICATION EFFICIENCY. Internatl. Comn. Irrig. and Drain., 5th Cong. Quest. 16: 145-159. 1963.

Efficient use of water in irrigated agriculture was found to be as important in areas of plentiful water supply as it was in water-short areas. Much of the water delivered to the farm for irrigation was lost while it was applied to the land because of the management practices that were used.

Field-water application efficiency is the percentage of water delivered to a field that is stored in the soil within the root zone of the growing crop. Factors affecting field-water application efficiency in irrigation are climate, soil, crop, water supply, topography, method of irrigation, irrigation system design, and irrigation system operation.

Water is applied to the land by four general methods: Flooding; furrows; sprinkler; and subirrigation. Each of these methods has characteristic water losses, but all losses can be classified under evaporation, deep percolation, or runoff.

Water-application efficiency studies were conducted at a number of locations in the United States. A study conducted near Boise, Idaho was summarized to compare the

field-water application efficiencies of the furrow, border, contour border, and sprinkler methods of irrigation of crops in a grain-legume rotation on 3 to 5 percent slopes.

The contour border method of irrigation gave the highest water application efficiency for the greater depth of soil moisture replacement each irrigation, while the sprinkler method gave the highest efficiency for shallow depths of soil moisture replacement.

The water application efficiency obtained was higher than those measured on farmer irrigated fields with similar soils, slopes, and crops. This was because more control equipment, more labor, and better land preparation was used in the detailed study.

Maximum water application efficiency required good water control equipment, proper land preparation, correct irrigation system designs, and proper management of the irrigation system.

SWCRD, ARS, USDA, Boise, Idaho. 83701

Blaney, H. F., and Criddle, W. D. DETERMINING CONSUMPTIVE USE AND IRRIGATION WATER REQUIREMENTS. U.S. Dept. Agr., Agr. Res. Serv. Tech. B. 1275, 59 pp. 1962.

Many factors influence the amount of water consumed by plants. The more important natural influences are climate, water supply, soil, and topography. The climatic factors believed to have the greatest effect on consumptive use on which data are generally available are temperature, precipitation, humidity, wind movement, and growing season. Irrigation practices, as well as kind of crops grown, their stage of growth, and species, also influence the amount of water consumed.

Results of experimental studies were given. An empirical formula was developed from these results, showing the relationship between temperature, length of growing season, monthly percentage of annual daytime hours, and consumptive use of water. From this relationship, consumptive use of water by crops and natural vegetation and an irrigation requirement can readily be estimated for any area where the basic climatological data are available.

The procedure was developed by correlating measured consumptive-use data with monthly temperature, monthly percentages of yearly daytime hours, precipitation, and growing or irrigation season. The coefficients thus developed allow for the computation of consumptive use of each crop if the monthly temperature, latitude, and growing period of the crop are known and if the computed monthly percentage of annual daytime hours are available.

Estimated seasonal consumptive use in inches can be computed from the formula

$$U = KF$$

where U = use of water in inches;

K = empirical seasonal coefficient;

F = sum of the monthly factors (f) for the season-sum of the products of mean monthly temperature (t) in degrees Fahrenheit and monthly percentage of annual daytime hours (p).

The equation for monthly or short-period consumptive use in inches was $u = kf$.

The seasonal coefficient (K) for each crop appears to be approximately constant for most areas where irrigation is practiced. However, the coefficients do not appear to be constant for consecutive short periods during the growing season. Adjustments can be made in areas where data are available. For short periods and higher temperatures, the coefficient k appears to be larger. But temperature is not the only factor affecting consumptive-use relations. Each crop has its own particular growth and water-use pattern.

Thus, for short periods, use coefficients vary, depending upon temperature and stage of growth.

The net amount of irrigation water necessary to satisfy consumptive use during any period is found by subtracting the effective precipitation and other available water from the total requirement for the period. This net requirement of irrigation water, divided by the irrigation efficiency, is the overall water requirement to satisfy the needs of the crop. If efficiency measurements are not available, they can be estimated by taking into account irrigation practices, soil characteristics, topography, skill of the irrigator, degree of land preparation, and availability and cost of water supplies. Irrigation efficiency may be measured in the field, but such measurements are expensive and are often estimated by making allowances for certain wastes such as ditch seepage, deep percolation, and surface runoff. The net consumptive irrigation requirement corrected for conveyance and application losses is the irrigation diversion requirement.

Terms used in this report were defined.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Robinson, F. E., Campbell, R. B., and Chang, J. ASSESSING THE UTILITY OF PAN EVAPORATION FOR CONTROLLING IRRIGATION OF SUGAR CANE IN HAWAII. Agron. J. 55: 444-446. 1963.

The timing of irrigation applications was determined from net evaporation from a U.S. Weather Bureau pan. Maximum sugar yields were obtained when 2.5 inches of irrigation water were applied after 2.9 inches had evaporated from the pan.

Length of stalks was a reliable indicator on the effect of soil-moisture deficit upon sugar yields of cane. The difference in yield attributed to the 6 irrigation treatments reflected the variation in stalk length resulting from treatment-induced soil-moisture stress. Irrigation treatments and population densities both caused highly significant differences in the yields of plots. Decrease in stock length resulted from soil moisture tensions which exceeded two bars.

Expt. Sta., Hawaiian Sugar Planters Assn., Honolulu, Hawaii.

Corey, G. L., and Fitzsimmons, D. W. INFILTRATION PATTERNS FROM IRRIGATION FURROWS. Idaho Agr. Expt. Sta. Res. B. 59, 16 pp. 1962.

The theory, apparatus, and procedures for studying unsaturated flow from irrigation furrows with an electric analog were given. The data and analysis were rather limited in extent and did not represent the completed project.

The wetted perimeter of a furrow was an important variable when considering the quantity of water that was discharged from it into the soil. A trail analysis was made using hydraulic radius as a variable, but no greater significance was obtained.

The results indicated that the depth of soil below the furrow had little effect on the discharge and this was eliminated as a variable.

The results were preliminary in that the analysis was based entirely on the assumptions that the soil profile was uniform, the furrow spacing was 30 inches, and the flow was steady state.

Future research will be conducted to determine the effects of furrow spacing, soil types, and soil variability within the profile.

U. Idaho, Col. Agr., Idaho Agr. Expt. Sta. Moscow, Idaho.

Smerdon, E. T., Hohn, C. M., Newman, J. S., and Thaxton, E.I., Jr. WATER DISTRIBUTION ALONG SURFACE IRRIGATION RUNS. Tex. Agr. Expt. Sta. Prog. Rpt. 2275, 4 pp. 1963.

In Texas, infiltration rates, which occurred during furrow irrigation, were determined for Reagan sicl soil at Pecos, Miller sicl soil at College Station, and Amarillo 1 soil at Lubbock. Uniformity of water distribution was determined for the three locations and compared. The soil at Pecos gave the most uniform distribution though the irrigation runs were the longest. The cracked soil at College Station gave the lest uniform distribution of water in spite of very short runs.

Differences in uniformity of water distribution along irrigation furrows at a given location resulted from variations in stream sizes used and the effect of different grades in individual furrows. However, variations in uniformity of distribution of water along the run were much greater when furrows from different locations were compared. This was due primarily to the differences in infiltration rates of the different soils.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Brown, L. N. IRRIGATION ON STEEP LAND. Calif. Agr. Expt. Sta. Ext. Serv. C. 509, 26 pp. 1962.

Irrigation on steep land can be a problem on slopes of 2 percent or more. In such cases, proper irrigation methods will save water, conserve soil, and produce better crops. Success will depend not only upon the method of irrigation, but also upon the rate at which water is applied, the cover on the soil, and texture of the soil.

The main irrigation methods discussed were: (1) Furrows; (2) strip checks or borders; (3) return water systems; (4) contour ditches; (5) sprinklers; and (6) basin irrigation.

California farmers have been ingenious in developing many variations of these methods to meet the State's great variations in water supply, topography, soil, climate, and crops. This circular brings together these methods to help specific situations.

Calif. Agr. Expt. Sta. Ext. Serv., Berkeley, Calif.

van't Woudt, B. D. DISCHARGE FROM MOVING IRRIGATION PIPE. Internatl. Comn. Irrig. and Drain., 5th Cong. C6: 73-82. 1963.

Cantilevered pipes, moving close over the crop or soil surface, have given a means for obtaining a theoretical 100 percent efficiency in irrigation applications. The method has been in need of a low-pressure discharge mechanism with low-impact energy at the ground surface. The development of a mechanism in which energy dissipation, a satisfactory drop-size, and water distribution pattern were achieved by a cup-shaped deflector suspended below orifices of 0.228 inch diameter on the underside of the cantilevered pipes was reported.

The impact energy in the deflected discharge was 250 to 500 times lower than the undeflected discharge for four assumed field conditions and compared favorably with that of natural rain and conventional sprinkler irrigation.

U. Hawaii, Honolulu, Hawaii.

Rice needs water of uniform depth throughout the field to ensure good growth and satisfactory control of weeds. To provide this, bunds or levees are usually constructed in situ using topsoil. These exposed levees take up useful space and serve as a site for weed growth. The use of black polyethylene film for construction of levees could overcome these disadvantages and provide a saving in land preparation and harvest.

Several successful plastic levees were used at the rice experiment station at Biggs, Calif., in 1959-60. Several widths and thickness of plastics were tried at a number of stake spacings. The most desirable construction was with 8-mil black polyethylene 24-28 in. wide, fastened to 1-in. x 2-in. x 30-in. stakes driven 16 in. into the ground at 4-ft. spacings. A piece of lath 1½ in. long with one shingle nail provided an excellent fastener, but did not lend itself well to mechanization. The bottom edge of the plastic which forms the apron to be covered in the furrow should be 8 to 12 in. wide and covered 2 to 3 in. deep. The bottom of this furrow should be flat and firm. Difficulty was experienced with deep V-furrows. The apron sagged into the bottom of the furrow when the soil was flooded and the water washed out underneath the plastic. The stakes should be of Douglas fir for strength.

The following savings were attributed to the use of plastic levees over dirt levees: (1) Land preparation costs were reduced \$3.00 per acre; (2) harvest costs were reduced \$4.00 per acre; (3) a 5 percent increase in field space due to plastics gave an average yield increase of 2½ sacks of rice or \$10.00 per acre; and (4) an increased yield due to better weed control.

The savings in tillage, harvest, and cropping provided savings of \$17.00 per acre. Plastic levees cost \$13.60 per acre and dirt levees cost \$3.10 per acre. This gave, for the plastic levees, an estimated profit of \$6.50 per acre over dirt levees.

The Ford Foundation.

Gallatin, M. H., Lunin, J., and Batchelder, A. R. BRACKISH WATER IRRIGATION OF SEVERAL VEGETABLE CROPS IN HUMID REGIONS. Agron. J. 55: 383-386. 1963.

Use of brackish water for irrigation of vegetable crops was investigated on replicated field plots from 1956-61. The six irrigation treatments used were: (1) No irrigation; (2) tap water irrigation; and (3 to 6) 4 dilutions of sea water having electrical conductivities of 1, 2, 4, and 6 mmhos./cm. Potatoes, tomatoes, beans, and onions were planted each spring and cabbage, peas, beans, and turnips each fall. One-inch irrigations were applied to the appropriate treatments when the soil water suction in the fresh water-irrigated plots reached 1 bar. Soil samples were collected at the beginning and end of each crop to determine the degree of salt accumulation.

This study indicated that many factors determine the results obtained when using brackish water for irrigation of vegetable crops. In general, the salt tolerance of the crops studied conformed to published data. The level of soil salinity varied throughout the growing season. The resultant effect of saline irrigation on yields was governed by two major factors: (1) The degree of salt accumulation in the soil as affected by the salt concentration of the water applied, the number of irrigations applied, and the rainfall distribution throughout the year; and (2) the salt tolerance of the specific crop with particular emphasis on the stage of growth during which high salinity levels were attained in the soil. Climatic conditions other than rainfall may have been a factor.

SWCRD, ARS, USDA, Norfolk, Va.

Struchtemeyer, R. A., Epstein, E., and Grant, W. J. SOME EFFECTS OF IRRIGATION AND SOIL COMPACTION ON POTATOES. Amer. Potato J. 40: 266-270. 1963.

Supplemental irrigation increased yield and number of tubers in 3 of the 4 years studied. There was no significant effect of irrigation on the specific gravity of Katahdin potatoes.

A separate study relating the effect of compaction on potato yield indicated that sprayer traffic reduced yields from 8 to 31 percent.

Maine Agr. Expt. Sta., U. Maine, Orono, Maine.

Brigham, R. D., Stapp, B. R., Walker, H. J., and Lyles, W. E. FERTILIZER RATE TEST ON THREE VARIETIES OF CASTORBEANS GROWN ON SPRINKLER-IRRIGATED SANDY SOILS, GAINES COUNTY, TEXAS, 1962. Tex. Agr. Expt. Sta. Prog. Rpt. 2277, 3 pp. 1963.

Three dwarf-internode castorbean varieties were grown in a replicated test under six fertility levels on sprinkler-irrigated sandy soils in Gaines County, Tex. Hale Hybrid and Hale produced higher yields and showed greater response to fertilizer than Dawn. Averaged across all fertilizer treatment, Hale Hybrid, Hale, and Dawn produced 2465, 2122, and 1717 pounds per acre, respectively.

The highest yield, averaged across varieties, was produced by castorbeans fertilized with 80 pounds of nitrogen, 40 pounds of phosphorus (P_2O_5) and 40 pounds of potassium (K_2O) per acre.

Increased yields resulted from the addition of 40 pounds of nitrogen to the 40-40-40 treatment and from the addition of 40 pounds of phosphorus (P_2O_5) to the 120-0-0 treatment. No response was observed with the addition of 40 pounds of potassium (K_2O) to the 120-40-0 treatment.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Amemiya, M., Namken, L. N., and Gerard, C. J. SOIL WATER DEPLETION BY IRRIGATED COTTON AS INFLUENCED BY WATER REGIME AND STAGE OF PLANT DEVELOPMENT. Agron. J. 55: 376-379. 1963.

Soil water depletion by irrigated cotton was studied on Willacy 1 in the Lower Rio Grande Valley of Texas. There was a characteristic parabolic relation between the rate of soil water depletion and stage of plant growth. The rate of water depletion increased throughout the early growth stage, reaching a maximum at the time of early bloom. This high rate of depletion continued for 5 to 6 weeks during boll development. High soil moisture extended the period of peak water depletion, and increased the rate and amount of water depletion.

Prior to bloom, most of the water depletion was from the top 2 feet of the profile. During fruiting, greater amounts of water were extracted from the third and fourth foot. Cotton plants may extract water from depths below their primary root zone (0 to 3 feet). Due to a lack of sufficient absorbing roots, the rate of water extraction from below 3 feet may not be sufficient to maintain optimum plant growth during periods of peak demands.

SWCRD, ARS, USDA, Ames, Iowa. 50010

MacKenzie, A. J., and van Schaik, P. H. EFFECT OF NITROGEN ON YIELD, BOLL, AND FIBER PROPERTIES OF FOUR VARIETIES OF IRRIGATED COTTON. Agron. J. 55: 345-347. 1963.

The effects of nitrogen on yield, boll, and fiber properties of four varieties of irrigated cotton were studied during the 1959-60 seasons. Both variety and N were important factors influencing yield, plant characteristics, and boll properties. Variety was the only major factor affecting fiber and spinning properties.

All varieties responded similarly to the applied N. Yield responses to N were shown by all varieties with rates of application up to 120 pounds per acre. Higher rates of N gave no increases or decreases in lint yield. N generally decreased the proportion of the total crop harvested in the first picking. Plant height was increased by higher rates of N, but root density and distribution were affected only by varietal differences. Lint index, boll size, and seed index were increased by N additions. The number of seeds per boll was not affected consistently in both years.

The Acala 4-42 variety produced a slightly longer, stronger, and finer fiber than the other three varieties. Deltapine-15 and Smooth Leaf had the weakest and coarsest fiber while R15's fiber was shortest but intermediate in fineness and strength. This varietal order held true regardless of N rate.

SWCRD, ARS, USDA, Brawley, Calif. 92227

Dudley, R. H., Hudspeth, E., and Walker, H. FERTILIZER PLACEMENT TRIALS--IRRIGATED COTTON, LUBBOCK, TEXAS. Tex. Agr. Expt. Sta. Prog. Rpt. 2271, 4 pp. 1963.

Recommended rates of plant nutrients for maximum yields of cotton may be applied at the time of planting. Irrigated cotton yields on Amarillo soil were not significantly different because of fertilizer placement treatments except when the fertilizer was placed with the seed. Fertilizer placed in contact with the seed significantly reduced cotton stands.

In 1961, 11 pounds of nitrogen and 48 pounds of phosphorus (P_2O_5) placed near the seed level and 2 inches to the side at time of planting produced as much or more lint than 80 pounds of nitrogen and 40 pounds of phosphorus (P_2O_5) sidedressed 10 inches to the side of the row 2 weeks after planting.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Marshall, S. P., and Myers, J. M. UNIRRIGATED AND IRRIGATED ALFALFA-OAT-CLOVER PASTURE FOR DAIRY CATTLE. Fla. Agr. Expt. Sta. B. 659, 16 pp. 1963.

Irrigated and unirrigated pasture mixtures of alfalfa, oats, and clovers grown on Scranton lfs were grazed with separate groups of dairy heifers during 2 years. Unirrigated pasture mixtures were grazed during two additional years. Total digestible nutrients obtained annually per acre averaged 4,617 pounds for the irrigated pastures, which was 1,520 pounds above that obtained from the unirrigated pastures for the 2 years. Total digestible nutrients obtained per acre from the unirrigated pasture during 4 years averaged 4,585 pounds and ranged from 1,670 to 7,098 pounds per year.

Grazing was begun 14 and 51 days earlier on irrigated pastures than unirrigated pastures during the 2 years, but grazing terminated on the same dates. Distribution of feed supply was more uniform on irrigated pastures, but there was no improvement in average daily gains of animals grazing this forage.

Annual body weight gains per acre for the two pasture seasons averaged 701 pounds for heifers grazing irrigated pastures and 438 pounds for those grazing unirrigated pastures. Growth rate of the animals, expressed as percentage of the Missouri Standard, was 128 percent for those on irrigated pastures and 142 percent for those on unirrigated pastures. During the four grazing seasons on unirrigated pastures, the heifers made annual average gains of 637 pounds per acre, and their growth rate averaged 128 percent of the Missouri Standard.

Feed replacement value of the unirrigated pastures was calculated as \$206 per acre and the net return as \$135.50 per acre. Total production cost was calculated at \$70.50 per acre. Production cost of total digestible nutrients pasture averaged 1.54 cents per pound.

Average annual applications of 17.7 inches of water during 2 years, in which precipitation was subnormal, increased the calculated feed replacement value of the pastures \$70 per acre. This was an average increase in value of \$3.95 per acre inch of water applied and considered to be in the profitable range for low-cost sprinkler-type irrigation operations.

Alfalfa supplied most of the forage in the pasture mixture during fall and winter and practically all during spring and summer. Oats furnished a minor portion of the forage during fall and winter. Clovers produced very little forage due to overshadowing by alfalfa and oats.

Low alfalfa plant populations in late summer made annual reseeding advisable. Reduction in stand of alfalfa plants apparently was caused by diseases.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Newman, J. S. CHEMICAL CONTROL OF ANNUAL WEEDS ON IRRIGATION BORDERS.
Tex. Agr. Expt. Sta. Prog. Rpt. 2268, 4 pp. 1963.

Complete control of careless weed, tumbleweed, and lamb's-quarters 3 inches in height was obtained on irrigation borders when 1.0 or 1.25 pounds of diuron (Karmex DL, a liquid) with 1 or more pounds of surfactant (Sterox AA) in gallons of water per acre was applied as a post-emergence foliar spray. No weeds were killed when Karmex DL was applied without a surfactant. Karmex DW (a wettable powder) alone or with a surfactant did not produce acceptable weed control when applied as a post-emergence foliar spray.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Anderson, R.L. IRRIGATION ENTERPRISES IN NORTHEASTERN COLORADO: ORGANIZATION, WATER SUPPLY, COSTS. U.S. Dept. Agr., Econ. Res. Serv. ERS-117, 18 pp. 1963.

Irrigation development in the South Platte Basin in northeastern Colorado has largely been by private organizations. There are over 100 such enterprises operating in the area. The variation in size of operation, costs of water delivery, and market value of water among the 106 irrigation enterprises in the area were reported.

The total area irrigated by these enterprises was about 720,500 acres, from a long-time average annual water supply of 888,000 acre-feet of natural streamflow and over 260,000 acre-feet of water stored in reservoirs. The area annually received an additional 180,000 to 290,000 acre-feet of supplemental water from the Northern Colorado Water Conservancy District (NCWCD). The data does not include the NCWCD water, as most of it was allocated to individual users rather than to irrigation enterprises.

The land served per irrigation enterprise ranged from 140 to 55,000 acres. Stock issues varied from 8 to 10,000 shares per company. A share of stock provides water to a minimum of 0.3 acre to a maximum of 160 acres of land. About 60 percent of the shares provided water to less than 20 acres.

The amount of water delivered to individual stockholders was proportional to stock held, rather than to acres of irrigated land under the system.

Reservoir companies usually supply water to a number of irrigation companies. Almost 95 percent of the reservoir companies allocate less than 20 acre-feet per share; individual reservoir deliveries range up to 33,000 acre-feet.

Annual assessment charges on irrigation water vary with the amount of water supplied per acre and the size of the area serviced. Generally, enterprises with the largest service areas deliver the smallest amount of water per acre. Those delivering up to 1 foot per acre serve areas of over 15,000 acres; their assessment charges average \$1.14 per acre-foot. The companies delivering over 3 feet per acre assess an average of 34 cents per acre-foot delivered and have service areas averaging 2,500 acres. Reservoir water assessments average \$2.05 per acre-foot, and range from 21 cents to \$6.49 per acre-foot.

Market prices of irrigation stock in the area were quoted from \$10 to \$15,000 per share. The market value of water stock in companies serving less than 1,000 acres averaged \$5.40 for the annual delivery of 1 acre-foot. Companies serving between 1,000 and 3,000 acres had an average market value for water of \$17.00 per acre-foot delivered annually. In companies with service areas of 3,000 to 13,000 acres, the average value of water was \$27.00. For companies serving more than 13,000 acres, water stock was valued at an average of \$40.23 per acre-foot delivered annually.

Irrigation enterprises were organized mainly as farmer-owned mutual companies and are fairly responsive to the wishes of the water users. There appear to be many more enterprises than necessary to provide water service to the irrigated land in the area. However, the absence of pressure to reduce delivery costs or to become more efficient in water use, coupled with the legal difficulty of changing diversion points, makes consolidation of systems unlikely in the foreseeable future.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Ellis, H. H. WATER LAW IN EASTERN UNITED STATES. J. Soil and Water Conserv. 18: 19-27. 1963.

Competition for natural resources has caused man to devise various systems for their allocation to individuals and groups. Even in the relatively humid eastern part of the United States, expanding needs for water resulted in an elaborate system of water rights and law. The general nature of water laws in relation to water resources development in the 31 Eastern States was described.

ERS, USDA, Madison, Wis.

Drainage

Ligon, J. T., Johnson, H. P., and Kirkham, D. GLASS BEAD-GLYCEROL MODEL FOR STUDYING FALLING WATER TABLE BETWEEN OPEN DITCH DRAINS. Trans. ASAE 6(1): 61-64. 1963.

The application of the theory of similitude to the modeling of problems involving unsteady state soil drainage was investigated.

A model of a ditch drainage system was designed and constructed using glass beads as the porous medium and glycerol as the fluid. Properties of the fluid and porous medium, as well as the geometrical relationships of the system, were considered. Experimental runs were conducted with the ditch drainage model for a variety of geometrical relationships. The water-table drawdown data were plotted in dimensionless form. Where possible the data were consolidated and general expressions for drawdown obtained.

It was concluded that the application of the theory of similitude in the modeling of systems involving flow through porous media was feasible. Further investigations are needed, particularly with regard to the effect of a capillary fringe on the performance of such systems.

U. Ky., Lexington, Ky.

Schwab, G. O., Thiel, T. J., Taylor, G. S., and Fouss, J. L. TILE AND SURFACE DRAINAGE OF CLAY SOILS: I. HYDROLOGIC PERFORMANCE WITH GRASS COVER. Ohio Agr. Expt. Sta. Res. B. 935, 48 pp. 1963.

Replicated drainage systems were established on a heavy clay lakebed soil near Sandusky, Ohio. The systems included no drainage (level), surface drainage, tile drainage (level), and a combination of tile and surface drainage. A uniform stand of grass (Kentucky 31 fescue) was established over the entire experiment. The plots were irrigated twice in 1960 and twice in 1961 to simulate heavy rainfall that would normally occur once in 10 to 15 years. Tile and surface flow, water table height, and soil moisture content were collected for these irrigation periods. Antecedent soil moisture was near field capacity prior to one irrigation and low (dry surface) on the other three. Water was applied by sprinklers at two rates (0.23 and 0.51 inches per hour). Surface drainage greatly reduced tile flow, and tile drainage reduced surface flow volume about the same amount. Evaluation of the drainage systems was based entirely on hydrologic measurements rather than on crop response. The authors concluded that:

1. The combination tile and surface drainage system gave the best drainage. Tile plus surface flow volume varied from 0.10 to 0.95 inches greater than the amount of water removed by either the tile system or surface drainage system alone.
2. Except for high antecedent moisture conditions, tile-drained (level) plots gave about the same degree of drainage as the surface-drained (no tile) plots.
3. Surface drainage reduced the amount of water removed by the tile by 43 percent and tile drainage reduced the amount of surface runoff about 40 percent.
4. High antecedent moisture increased tile flow volume 100 percent and the surface runoff volume more than 150 percent, but peak tile flow rates were increased only slightly and peak surface runoff rates were increased about 20 percent on the average.
5. Doubling the rate of water application increased the peak tile and surface flow rates, but had little effect on the volume of flow.
6. The average rate of drop of the water table for the first 3 days following irrigation was 0.52 foot per day for the surface drainage only, 0.55 foot per day for tile drainage only, and 0.67 foot per day for the combination tile and surface drainage. In the undrained plots the ponded water receded about 0.04 foot per day or roughly double the evapotranspiration rate.
7. The rate of decrease of soil moisture content at the 6-inch depth following irrigation corresponded generally to the water table levels, but rate of change (on the order of 0.3 to 0.6 percent per day) was too small to measure accurately drainage differences with the neutron soil moisture meter.

8. Tall fescue can withstand rather severe drainage conditions. Some reduction in growth and loss of stand occurred in the undrained plots, which were flooded several times for periods up to 10 days.

Photographs, tables, and graphs.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Triplett, G. B., Jr., and Van Doren, D. M., Jr. DEVELOPMENT OF A DRAINAGE VARIABLE FACILITY FOR SOIL AND CROP MANAGEMENT STUDIES ON A LAKEBED CLAY SOIL: I. ESTABLISHMENT OF DRAINAGE TREATMENTS AND THEIR PRELIMINARY EFFECT ON CROP YIELD. Ohio Agr. Expt. Sta. Res. C. 117, 25 pp. 1963.

Some of the crop production and management problems peculiar to the plastic, fine-textured soils of northwestern Ohio have been studied on a 58-acre experimental site since 1955. The plots were designed with four replications with and without tile drainage. Long term experiments have been initiated on the area.

Uniformity trials with corn as the indicator crop in 1958 and oats in 1959 were grown on all or portions of the site in order to assess the amount of soil induced crop yield variability present. Results of these uniformity trials showed extreme significant variations in yields which made the site unsatisfactory for experimental work.

A map of ponded water was made after a heavy rain on April 28, 1959. Lower corn yields in 1958 and lower oat yields in 1959 were associated with ponding on the non-tiled ranges, and to a lesser extent on the tiled ranges. Land forming operations designed to eliminate ponding and reduce variability were conducted after harvest in 1959 and 1960. Low spots were filled and soil was moved from the edges to the center of each range to insure positive surface drainage.

Corn yields in 1961 reflected a marked reduction in soil induced plant variability on both tiled and non-tiled areas. Over 80 percent of the plot yields were within ± 10 percent of the mean in tiled and non-tiled areas and the variances for the two areas were not significantly different.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Houston, C. E. DRAINAGE OF IRRIGATED LAND...IT'S EXPENSIVE, BUT CAN PAY OFF HANDSOMELY. Calif. Agr. Expt. Sta. Ext. Serv. C 504, 40 pp. 1961.

Drainage systems are often complicated and expensive, but properly installed they can be made to pay off in both tangible and intangible results--better crops, soil conservation, improved health conditions, and greater convenience for the farm operator.

Many questions that come up before and during installation of drainage systems were explained.

Calif. Agr. Expt. Sta. Ext. Serv., Davis, Calif.

Evaluation of Flood Water Damage

Kinori, B. Z., and Dlayahu, E. ECONOMIC EVALUATION OF DRAINAGE AND FLOOD CONTROL IN SEMI-ARID REGIONS. Tahal Water Planning for Israel LTD. Reprint of a paper presented at the Internatl. Comn. Irrig. and Drain., 5th Cong. 23 pp. 1963.

The possibilities and difficulties of a sound economic evaluation of drainage and flood control works were shown. Some of the problems mentioned were too complicated for the

average drainage engineer without the assistance of an economist. Nevertheless, it is important for the engineer to understand the underlying principles of economic analysis and its goals.

One of the most difficult problems arising in developing countries is the scarcity of data needed for economic calculations. There is a lack of data on the influence of drainage on crops and yields in different climates and soil conditions and of data related to the direct and indirect influence of drainage and flood control projects under various different conditions.

Tahal Water Planning for Israel, Ltd., Tel Aviv, Israel.

Storage and Conveyance

Jamison, V. C., and Thornton, J. F. SEALING FARM PONDS IN MISSOURI. Mo. Agr. Expt. Sta. Res. B. 817, 28 pp. 1963.

Field testing with leaking ponds in Missouri has proceeded far enough to make some recommendations. These were based on principles outlined from work elsewhere, on the results of the laboratory and model studies, and on field observations.

Ponds that leak badly only after they reach a certain level can be sealed by treatments around the water line zone. Unless the leak is through very porous materials or channels, puddling will improve the seal. This may be done with a harrow, disk or even a rotary hoe. Farm animals may be kept near the leaking region to trample the soil. For a leak through chert, gravel, or rock seams, it will be necessary to compact a blanket of soil (1 foot or more in thickness) over the faulty area when the pond is dry or the water has been drained below this level. A loamy material with no more than about 20 percent clay will be suitable for this.

The fill should be inspected for evidence of seepage. To repair serious leakage in a fill at and above the contact base, the basin side of the pond fill should be compacted and, if the material is composed of cherty aggregates, it will be necessary to compact a loam blanket over the basin face of the fill.

For a pond basin that is dry most of the time because the area is excavated in porous chert and aggregate--and the fill is also porous because it is composed of the same material--it will be necessary to compact a loam blanket over the whole basin area including that of the fill. For the more porous spots, 6 inches or more of sandy loam material should be applied and compacted. If sandy loam is not available, silt loam may be used. A blanket of silt loam should then be spread and compacted over the entire area. Compaction may be accomplished with a heavy sheepfoot roller or a weighted disk.

The current specifications for at least 8 feet of storage depth should be maintained. It may be desirable to achieve this with higher fills rather than deep cuts, particularly in some of the Ozark soils similar to the Baxter and Newtonia series. Desirable storage volume may be provided by cutting the basin somewhat deeper farther from the fill but not so deep as to intercept porous layers in the basin near the fill.

Ponds with normal drainage should fill in a reasonable length of time after construction, probably no longer than 1 year of normal rainfall. Estimated seepage losses, after a reasonable correction is made for evaporation, should not exceed 2 inches per month. In Missouri, seepage plus evaporation should not exceed 12 inches in a hot, dry summer month and should be no more than 4 inches in a cool winter month.

Where possible, the soils with highly permeable or faulty conditions in the subsoil should be avoided. If the owner has good reason to construct a pond in such soils, he should be sure suitable blanket material is available adjacent to the site. The fill should be keyed

into an impervious layer or a compacted blanket should be spread as a bag seal over the basin, including the basin side of the fill. The seals in some ponds with moderate seepage rates may be improved by a heavy application of barnyard manure. The use of manure may be objectionable from the standpoint of contamination. Laboratory tests and practical experience with sewage lagoons have demonstrated that such contamination in the water is short-lived, due to decomposition. Manure treatments in ponds having high seepage rates may be disappointing.

The owner may not wish to keep cattle in a pond area to disperse and improve the seal in an aggregated clay pond basin. He may prefer to use chemical dispersants in lieu of or in conjunction with mechanical methods. The hexametaphosphate used costs about \$250 per ton delivered at Columbia. A satisfactory seal was obtained with about 2 tons/acre-6 inches with the Baxter red clay aggregates. The tripolyphosphates were comparable in cost, though less effective. Chemicals such as the polyphosphates will greatly reduce the soil manipulation needed to produce a dispersion seal. Adequate support below the sealed layer should be provided to insure against blowout failures. A blanket of loam or a mixture of about equal parts of the clay aggregate material with silt loam about 1 foot in thickness should be spread over the faulty areas. The chemical should be stirred into the soil surface and the soil compacted with a weighted disk or a sheepsfoot roller.

Since it will usually take some time after soil treatment before there is enough runoff to fill a pond, precautions should be taken to protect the soil from drying and cracking. This may be done by spreading a mulch of straw manure, old hay, or straw on the surface before the final rolling or disking used to compact the blanket.

The area above the high water line should be seeded with a suitable sod-forming grass like fescue. If a manure fescue hay is used as the mulch on this area, it will serve to seed it as well as to protect it from erosion.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Stephens, J. C., Blackburn, R. D., Seaman, D. E., and Weldon, L. W. FLOW RETARDANCE BY CHANNEL WEEDS AND THEIR CONTROL. J. Irrig. and Drain. Div., ASCE 89 (IR 2): 31-47. June 1963.

The proper maintenance of canals infested with aquatic weeds presents serious problems when attempting to achieve design flow in waterways through the flat, fertile lands of the southeastern United States. Floating waterweeds raise the coefficient of roughness, n , to more than twice the clean-channel value, based on equal cross-sectional areas and channel geometry. Submersed weeds, such as southern naiad, can raise infested, as compared to clean, values almost twentyfold.

The effect of weeds in retarding flow was most pronounced in small channels with low velocities. Large channels (with or without aquatic weed infestations) that have hydraulic radii exceeding 20 ft. customarily have coefficients of roughness, n , between 0.024 and 0.031. In moderate-size channels having cross-sectional areas between 100 sq. ft. and 2,000 sq. ft., Manning's n values were less than 0.036 with light vegetative growth, between 0.036 and 0.052 for moderate growth, and exceeded 0.052 with heavy growth. Under conditions of infestation by submersed and emersed aquatic weeds, n values increase exponentially as the product of velocity and hydraulic radius decreased.

Submersed weeds were controlled by constructing channels with sufficient depth to exclude sunlight at the bottom where these plants take root. Limited control was achieved by biological agents such as herbivorous fishes, mammals, or insects. Mechanical means of control such as dredging, dragging, and cutting have been widely used. Most mechanical methods provided control only for short periods and often induced spreading of the infestation to other areas.

The use of herbicides has grown rapidly since 1946. Contact herbicides, including emulsifiable aromatic solvents, acrolein, diquat, and endothal, are giving good results on submersed aquatics. Soil sterilants such as the arsenicals, sodium chlorate, the substituted-urea compounds, triazine compounds, and ammonium sulfamate may be used on emersed aquatics when the herbicide can be safely and effectively applied to the soil. Some of the common systemic herbicides used on aquatics are 2,4-D; 2,4,5-T; dalapon; and amitrole-T.

SWCRD, ARS, USDA, Athens, Ga. 30601

BASIC SOIL SCIENCE

Soil Physics

Bateman, H. P. EFFECT OF FIELD MACHINE COMPACTION ON SOIL PHYSICAL PROPERTIES AND CROP RESPONSE. Trans. ASAE 6(1): 19-25. 1963.

A review of the literature on soil compaction indicates that many soil and plant interrelationships are affected by such factors as air voids, oxygen content of the soil air, mechanical impedance, moisture movement, tolerance of the roots to mechanical impedance, and the indirect effects on chemical and biological growth factors. Growing crops in soil with low air voids reduced growth and production, but it was difficult to isolate the reasons for these effects.

Corn growth may be expected to be retarded when the air voids at field capacity moisture are near the 10 percent value.

Many research results have demonstrated that tractor tire traffic can reduce air voids to the critical value of 10 percent or less in many soil types, and that low values were easier to develop at higher soil moisture contents.

The results of compaction produced by eight different machine treatments and the effects on corn growth in the 1960 and 1961 seasons were presented. The treatments were prepared on a Drummer silt soil and a Thorp sil soil receiving two rates of nitrogen. The author concluded that:

1. The compaction treatments created different percents of air voids in the tilled layer for the samples taken in the row. However, tire traffic between the rows increased the density to about the same level for all treatments. Tire traffic in the bottoms of the furrows did not create a dense layer that could be measured 5 months after it had developed.
2. In three of the higher compaction treatments on both soil types, the air voids at field capacity were near the critical value of 10 percent.
3. In Drummer soil, which has a high clay content, one series of soil-drying tests made under field conditions indicated that the shrinkage rate was less for the higher air void soil, and the air voids tended to increase as the soil dried. However, when the air voids were near the critical 10 percent value, the shrinkage rate was sufficient to keep them at about the same value as the soil dried.
4. The maximum air voids produced by the plow-plant method increased yields on both soils compared with the original density soil only at the low nitrogen rate. Lowering the air voids of Drummer soil to a medium value by disking the plowed soil increased the average yield for the 2 years only at the high nitrogen rate.

5. The higher compaction treatments caused significant yield decreases on the Drummer soil, but only a limited number of reductions on Thorp. On Drummer, the average reduction for three high compaction treatments was 12 bu. per acre at both levels of nitrogen, indicating that compaction was not influenced by the fertility differences used.
6. The Drummer soil appeared to be more susceptible than Thorp to compaction. Important factors in the difference were the higher clay content of Drummer and its normally higher moisture when the soil was tilled. These factors, along with a slower drainage rate and a higher shrinkage rate, tended to maintain low air voids and high mechanical impedance when Drummer soil was compacted. These compaction factors appear to be more critical in retarding root growth and reducing yield on Drummer soil than on Thorp soil.

U. Ill., Urbana, Ill.

Orlovskiy, V. B. CHANGE IN THE PHYSICAL PROPERTIES AND PARTICLE-SIZE COMPOSITION OF ERODED FOREST SOILS UNDER THE INFLUENCE OF FOREST PLANTATIONS. Soviet Soil Sci. 4: 424-428. Apr. 1962.

The changes in the physical properties and particle-size composition of eroded forest soils under the influence of forest plantations were studied in Russia. The author concluded that:

1. Changes in the physical properties of eroded gray forest soils were most pronounced under English oak and less pronounced under black locust plantations. No substantial improvements in the physical properties of eroded gray forest soils were found under European ash and white birch plantations (18 to 22 years old). These soils usually deteriorated under pure stands of Scotch pine.
2. The improvement in the physical properties of eroded gray forest soils occurred chiefly in the upper layers, touching on the forest litter, and involved the entire A horizon. The effect of plantations (18 to 22 years old) on the B₁ and B₂ horizons was manifested by their compaction and decrease in water permeability. There was an inverse relationship between the improvement of the physical properties of the A horizon and their deterioration in the B₁ and the B₂ horizons.
3. The structure and other physical properties of the A horizon improved under the effect of plantations, bulk density decreased, total and gravitational (non-capillary) porosities increased, and water permeability increased sharply. The sum of water-stable aggregates almost doubled under 18-year-old English oak plantations (with aggregates >3-5 mm. in diameter predominating considerably) as compared to the control, water permeability increased 14-fold (at a soil moisture of 16 percent), bulk density decreased to 21 percent, total porosity increased by 6 percent, while gravitational porosity increased six-fold.
4. The best trees for erosion control in the region of the Kanev dislocation were English oak on slightly and moderately eroded soils and black locust on more severely eroded soils.
5. The improvement in the water permeability of soils in microdepressions makes it possible to recommend that intermittent furrows be cut across slopes (along inter-row spaces) before the plantations close. Thinnings must be made carefully to avoid weakening the water-conservation properties of plantations (without lowering stand density below 0.8). Plantations must be mixed in order to obtain maximum crown density not only along the horizontal, but also along the vertical profile.

Scripta Technica Inc., 1000 Vermont Ave., N. W. Washington, D.C. 20005

Kanwar, J.S., and Prihar, S. S. EFFECT OF CONTINUOUS APPLICATION OF MANURES AND FERTILIZERS ON SOME PHYSICAL PROPERTIES OF PUNJAB SOILS. J. Indian Soc. Soil Sci. 10: 243-247. 1962.

The observations on aggregation, water-holding capacity, hydraulic conductivity, and water infiltration rates were made in the permanent manurial trials plots where farmyard manure and fertilizers were applied continuously. Farmyard manure did not prove in any way superior over fertilizers especially over ammonium phosphate in improving the physical condition of the soil.

Govt. Agr. Col., Ludhiana, Punjab, India.

Salter, P. J., and Williams, J. B. THE EFFECT OF FARMYARD MANURE ON THE MOISTURE CHARACTERISTIC OF A SANDY LOAM SOIL. J. Soil Sci. 14: 73-81. 1963.

Annual applications of farmyard manure for 7 or 8 years led to a significant increase in the available-water capacity of a sandy loam soil and in the volume of water released at low tensions. The available-water capacity increased, and the moisture characteristic was altered, as the soil became more compacted during crop growth in both 1960 and 1961. Differences in moisture characteristics between the manured and unmanured soil were greatest at harvesttime of the crop.

The available-water capacity of the top 6 inches of soil was increased up to 70 percent by the use of farmyard manure. The increased available-water status of the soil could be at least partially responsible for the higher yield obtained following additions of farmyard manure.

Natl. Veg. Res. Sta., Warwick, Wellesbourne, England.

Yamamoto, T. WATER STORAGE CAPACITIES OF SOIL UNDER FOUR DIFFERENT LAND USES IN HAWAII. U.S. Forest Serv. Res. Note PSW-S, 4 pp. 1963.

Soil pore volume and pore size were correlated with land use or vegetation cover type. The top foot of forest soils had more large pores and higher water-holding capacities than that of soils under cultivation, in pasture land, or in idle grassland.

Table.--Organic matter content, bulk density, and pore volume of soils under different land uses or vegetation cover, 0- to 12-inch depth

Land use	Bulk density		Total pore volume		Large pore volume		Organic matter	
	Mean ¹	Standard deviation	Mean ¹	Standard deviation	Mean ¹	Standard deviation	Mean ¹	Standard deviation
	G/cm. ³	G/cm. ³	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Forest	0.76	0.22	74	6	18	7	6.5	3.0
Pasture land	.81	.34	71	11	14	6	8.7	8.7
Cultivated areas	.88	.26	69	8	10*	4	5.0	5.0
Idle grassland	.93	.36	68	11	10*	6	5.1	4.2

¹ Number of sites: forest, 11; pasture land, 6; cultivated area, 10; idle grassland, 7.

* Significant at 0.05 level when compared to forest soils.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Lunt, O. R., Sciaroni, R. H., and Enomoto, W. ORGANIC MATTER AND WETTABILITY FOR GREENHOUSE SOILS. Calif. Agr. 17(4): 6. 1963.

Continued addition of sphagnum peat to a clay soil in greenhouse benches over a number of years resulted in a decrease in wettability, according to observations recently confirmed by laboratory evaluation. Water did not penetrate easily, and many of the soil particles remained dry following irrigation. The authors state that there is no practical method known at this time for preventing the development of nonwettability in these soils, but certain management practices reported may be helpful in coping with this problem.

U. Calif. Los Angeles, Calif.

Better Crops with Plant Food. MOISTURE AND FERTILITY...A SPECIAL ISSUE. Better crops with Plant Food 47(1): 1-56. 1963.

Some of the latest findings on moisture and soil fertility, were reported by nationally known agricultural scientists. The following papers were given:

1. Wadleigh, C. H. INTRODUCTION. SWCRD, ARS, USDA, Beltsville, Md. 20705
2. Barber, S. A. RAINFALL AND RESPONSE. Purdue U., Lafayette, Ind.
3. Pearson, R. W. GET FULL ADVANTAGE FROM IRRIGATION. SWCRD, ARS, USDA, Auburn, Ala.
4. Lang, A. L., Miller, L. B., and Johnson, P.E. FERTILITY PAYS IN FLOOD OR DROUTH. U. Ill., Urbana, Ill.
5. Humbert, R. P. POTASSIUM AND WATER ECONOMY OF PLANTS. Los Gatos, Calif.
6. WATER--AN EDITORIAL VIEWPOINT. Editor-Better Crops and Plant Food, Washington, D.C.
7. Norum, E. B. FERTILIZED GRAIN STRETCHES MOISTURE. N. Dak. State U., Fargo, N. Dak.
8. Henderson, D. W., Hagan, R. M., and Mikkelsen, D. S. WATER USE EFFICIENCY IN IRRIGATION AGRICULTURE. U. Calif., Davis, Calif.

Pallas, J. E., Jr., Harris, D. G., Elkins, C. B., Jr., and Bertrand, A. R. RESEARCH IN PLANT TRANSPIRATION: 1961. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 70, 37 pp. 1963.

Prediction equations for transpiration were developed from an extensive study of one species (red kidney beans) at the Southern Piedmont Field Station, Watkinsville, Ga. The limitations of the equations were discussed. Approximately 80 percent of the transpiration was accounted for. It is anticipated that through more precise monitoring the reliability can be increased.

Studies were made on numerous other species that emphasize the effect of soil moisture tension on transpiration.

Several cellular studies indicated that guard cells have the extraordinary ability to remain operative under extremely adverse conditions. Thus, the importance of guard-cell action assumes new proportions. The induction of guard-cell operation *in vitro* can be shown but not completely controlled. It was evident that photoactive and hydroactive movements occur, but much more remains to be learned of their interdependence and independence.

The pathway of guard-cell starch accumulation was partially elucidated. The mechanism(s) of starch breakdown in the guard cell is little understood.

The effects of five compounds as foliar sprays on the transpiration of several species were reported. No tested compound was outstanding in suppressing transpiration.

ARS, USDA, Inform Div., Room 645A, FCB, Hyattsville, Md. 20781

Holmes, R. M., and Robertson, G. W. APPLICATION OF THE RELATIONSHIP BETWEEN ACTUAL AND POTENTIAL EVAPOTRANSPIRATION IN DRY LAND AGRICULTURE. Trans. ASAE 6(1): 65-66. 1963.

Some of the relationships between actual evapotranspiration and potential evapotranspiration were explored in a growth chamber experiment and the results were applied to a problem in arid zone agriculture. Yields of wheat under these conditions were more reliably related to moisture stress determined by a method utilizing a decreasing rate of evaporative soil moisture loss, than by a method that does not.

With a suitable choice of constants, the outlined budget can be used in many different agricultural systems.

Plant Res. Inst., Res. Br., Canada Dept. Agr.

Weaver, H. A., and Stephens, J. C. RELATION OF EVAPORATION TO POTENTIAL EVAPOTRANSPIRATION. Trans. ASAE 6(1): 55-56. 1963.

A lysimeter installation was used at Fort Lauderdale, Fla., to study the relative importance of the various components of weather on potential evapotranspiration and free water losses, and the interrelationships between actual evapotranspiration and the climate, crop, and soil factors governing it.

St. Augustinegrass and Bell peppers were used as the test crops. Free water evaporation was measured from a standard class A U.S. Weather Bureau pan situated about 50 feet from the center of the lysimeter installation.

The open-pan evaporation accounted for between 80 and 85 percent of the variation in evapotranspiration and appeared to have a real value as an index of crop water requirements in the South Florida area where management did not permit soil water to become limiting.

Jr. Author, SWCRD, USDA, Athens, Ga. 30601

Power, J. F., Grunes, D. L., Willis, W. O., and Reichman, G. A. SOIL TEMPERATURE AND PHOSPHORUS EFFECTS UPON BARLEY GROWTH. Agron. J. 55: 389-392. 1963.

Soil temperatures near 59° F. were optimum for the growth of barley. By increasing the available P level, through either increased native soil or fertilizer P supply, the soil temperature range over which nearly maximum barley growth occurred was greatly increased. Growth responses to P fertilization were much more dependent upon soil temperature for soil low in P availability than for those medium in available P supply.

SWCRD, ARS, USDA, Mandan, N. Dak. 58554

Soil Chemistry and Mineralogy

Mitsui, S., and Ueda, M. CATION EXCHANGE CAPACITY OF CROP ROOTS AND ION UPTAKE. II. THE EFFECT OF CATION EXCHANGE CAPACITY OF SOIL AND PLANT ROOTS ON THE UPTAKE OF SOME CATIONS, PARTICULARLY OF MAGNESIUM. *Soil Sci. and Plant Nutr.* 9: 43-48. 1963

Red bean with large root cation exchange capacity (CEC) and wheat with small root CEC, respectively, were sown on the magnesium deficient soils with two different CEC to study the effect of CEC of plant root on the actual nutrient uptake. The results were: (1) High correlation coefficient was found between the magnesium or calcium uptake and the CEC of plant roots; (2) the uptake of calcium and magnesium was affected remarkably by wheat root; (3) according to CEC of plant roots, the cation uptake differed in relation to the base status of soils; (4) the uptake of magnesium was promoted by elevating the saturation degree of CEC; and (5) in case of wheat, the uptake of calcium and magnesium was remarkably inhibited by the addition of potassium.

U. Tokyo, Tokyo, Japan.

Wiklander, L., and Koutler-Andersson, E. INFLUENCE OF EXCHANGEABLE IONS ON RELEASE OF MINERAL-BOUND IONS. *Soil Sci.* 95: 9-15. 1963.

To study the specific influence of exchangeable ions on the release of lattice ions or nonexchangeable ions, three soils of different origin and mineral composition were saturated with H, Na, K, NH_4 , Mg, or Ca and stored in moist and aerobic condition, one series at 20° C. to 40° C. and the other at 20° C. After 1 and 2 years, the contents of exchangeable Na, K, Mg, Ca, Fe, Al, and Mn and extractable Si and P were determined. Certain physiochemical determinations of the soils before and after weathering were performed.

The experiments showed that the release of nonexchangeable ions was much higher the first year than the second. In the H series of the subsoils after 1 year, it amounted to 0.10 to 0.21 percent of the soil weight, corresponding to base saturations of 11 to 22 percent of CEC, thus indicating a rapid weathering process in this series. In the NH_4 -saturated soils, the mobilization of Na, K, Mg, and Ca totaled 5.3 to 7.9 percent in the topsoil and 8.5 to 15.5 percent of CEC in the subsoil.

The saturating ions proved to have a pronounced specific effect on the release of other ions. Thus, H strongly enhanced the mobilization of Mg. The same was true of NH_4 in comparison to Ca. In Mg saturated soils, no Ca, or only traces, were transferred into exchangeable condition. Both Mg and Ca reduced the total release of lattice ions despite relatively high losses of Na and K.

Royal Col. Agr., Upsala, Sweden.

Vasey, E. H., and Barber, S. A. EFFECT OF PLACEMENT ON THE ABSORPTION OF Rb^{86} AND P^{32} FROM SOIL BY CORN ROOTS. *Soil Sci. Soc. Amer. Proc.* 27: 193-197. 1963.

Placement of Rb^{86} and P^{32} in the soil affected their relative uptake by corn roots. Autoradiographic techniques were used to determine the uptake processes involved. Banding of the fertilizer rather than mixing with the soil affected Rb^{86} uptake more than P^{32} uptake. The diffusion rate for Rb^{86} in the soil was much larger than for P^{32} . Rb^{86} was translocated more extensively throughout the corn root than was P^{32} .

The greater uptake of Rb-86 from band applications appeared to be due to both a greater facility for uptake by a small portion of the root and a greater diffusion of Rb-86 out of the band.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Essington, E., Nishita, H, and Wallace, A. EFFECT OF CHELATING AGENTS ON THE UPTAKE OF Y91, Ru106, Ce144, AND Pm147 BY BEANS GROWN IN A CALCAREOUS SOIL. Soil Sci. 95: 331-337. 1963.

The influence of three chelating agents (DTPA, CDTA, AND EDDHA) on the uptake of Y-91, Ru-106, Ce-144, and Pm-147 (Promethium) by bean plants grown in a calcareous soil was studied. DTPA greatly increased the amount of Y-91, Ce-144, and Pm-147 accumulated in plant parts, especially in the leaves. CDTA increased the Y-91 and Pm-147 uptake but the uptake of Ce-144 was affected only slightly. EDDHA slightly increased the Y-91 and Pm-147 accumulation in the leaves but did not affect that of Ce-144. In general, the three chelates did not significantly affect the uptake of Ru-106 by plants. The application of chelating agents to the soil did not significantly change the dry-weight yield of the plants. Paper chromatography of leaf extract indicated that Y-91DTPA complex was present in the leaves of bean plants grown in a soil treated with Y-91 and DTPA.

U. Calif., Los Angeles, Calif.

Moschler, W. W., Stivers, R. K., Hallock, D. L., Sears, R. D., Camper, H. M., Rogers, M. J., Jones, G. D., Carter, M. T., and McClaugherty, F. S. LIME EFFECTS ON SOIL REACTION AND BASE CONTENT OF ELEVEN SOIL TYPES IN VIRGINIA. Va. Agr. Expt. Sta. Tech. B. 159, 47 pp. 1962.

Results of lime applications on 11 soil types (13 locations) in Virginia were given. The study was concerned with the effects of lime applications on soil reaction, base content, and cation relationships.

The experimental plots were located on private farms, and the results were representative of typical farm conditions. The soil types ranged from the coarse-textured soils in eastern Virginia to the fine-textured soils of limestone origin in western Virginia.

Ground limestone, at rates of 0 through 8 tons per acre, was applied in 1954. Yearly determinations were made of the changes that occurred for 7 years, 1954-61.

The highest rate of lime application increased soil pH to slightly below 7.0 in the silt loam and clay loam soils, and to slightly above 7.0 in the sandy loam soils. Indications are that the rate of decline in pH will be somewhat slower than the rate of increase. The lower rates of lime were more effective, per unit of weight, in increasing pH than were the higher rates. In terms of lime applied, a pH of 6.0 was relatively easy to attain, 6.5 more difficult, and 7.0 extremely difficult.

The unlimed plots tended to fluctuate in pH value by years, rising or falling slightly, and generally paralleling the behavior of the plots receiving lime in this respect. Exchangeable calcium and magnesium increased with the rate of lime and time after application. The silt loam and clay loam soils contained more exchangeable bases and cations, at a given pH level, than the sands and sandy loam soils. Collectively, the percentage base saturation of the soils increased 2.5 percent for each 0.1 increase in soil pH.

The statistical relationship between soil pH and percent base saturation varied from a low of 0.71 in Norfolk sl to a high of 0.97 in Sasafra s1 and averaged 0.91 for the 11 soils studied.

The statistical relationship between soil pH and exchangeable calcium and/or magnesium averaged about 0.90 for 8 soils and ranged down to 0.60 for the other 3 soils.

Va. Agr. Expt. Sta., Polytech. Inst., Blacksburg, Va.

Shickluna, J. C., and Lucas, R. E. THE pH, PHOSPHORUS, POTASSIUM, CALCIUM AND MAGNESIUM STATUS OF ORGANIC SOILS IN MICHIGAN. Mich. State U. Quar. B. 45: 417-425. 1963.

Soil test results from organic soils that were farmed for a number of years were summarized. The amount of calcium present at any given pH was dependent upon the cation exchange capacity of the soil. The lime requirement was best determined when the pH value was supplemented with the exchangeable calcium, the exchange capacity, and the percent calcium saturation values.

The magnesium status of organic soils was similar to that of calcium in that the amount present, even in very acid soils, was often adequate for normal plant growth. Over 90 percent of the soils tested were greater than 5 percent magnesium saturated.

A large number of the soils (63.6 percent) were less than 1 percent saturated with potassium and 91.4 percent were less than 2 percent saturated. Annual applications of potassium were generally required on organic soils.

Unlike potassium, phosphorus was not readily leached from organic soils, especially from those with a high sesquioxide content. However, the phenomenon of phosphorus fixation renders native and applied forms of phosphorus unavailable to plants, particularly on organic soils with pH values above or below pH 5.5. Of the soils studied, 51.2 and 73.4 percent contained less than 41 and 71 pounds of phosphorus per acre, respectively.

The intensive type of agriculture practiced on organic soils necessitates an accurate and frequent inventory of their nutrient reserves. Indiscreet application of fertilizer is neither good economics nor good soil management. Optimum yields can only be obtained when nutrient balance is maintained and when good, sound soil management practices are followed.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Brown, J. M., and Bartholomew, W. V. SORPTION OF GASEOUS AMMONIA BY CLAY MINERALS AS INFLUENCED BY SORBED AQUEOUS VAPOR AND EXCHANGEABLE CATIONS. Soil Sci. Soc. Amer. Proc. 27: 160-164. 1963.

Ammonia sorption by homoionic clay systems containing small amounts of adsorbed aqueous vapor was investigated by manometric techniques employing equilibrium measurements in a special sorption apparatus.

Sorption isotherms indicated that there was considerable interaction between ammonia sorption and moisture levels of the clays. At ammonia pressures below 60 to 100 mm. Hg, "dry" bentonite and halloysite sorbed more ammonia than comparable moist clays. At higher ammonia pressures, moist clays sorbed more ammonia than "dry" clays with the greatest amount of sorption occurring at the higher moisture levels.

There was evidence of competition between aqueous vapor and ammonia for sorption sites on the clays. The kind of cation on the exchange complex also exerted an influence on ammonia sorption by moist clay, the mechanism of influence probably arising in part through alteration of the quantity and nature of the water of hydration.

The same order of influence of exchangeable cations on ammonia sorption occurred with the moist clays as was previously reported for dry clays, i.e., Al-clay > Ca-clay > K-clay.

N. C. Agr. Expt. Sta., N. C. State Col., Raleigh, N.C.

Wallace, A. ROLE OF CHELATING AGENTS ON THE AVAILABILITY OF NUTRIENTS TO PLANTS. Soil Sci. Soc. Amer. Proc. 27: 176-179. 1963.

The presence of natural chelating agents is one of several possible explanations of how plants are able to obtain Fe which ordinarily in soil is very insoluble. The role of such chelating agents in plant nutrition is mostly an unexplored field. Synthetic chelating agents are proving useful in supplying Fe and to a lesser extent Zn and Mn to plants under conditions in which plants are subject to deficiencies of those metals. The chelating agents keep the metals soluble in the soil and are taken up by the plants with the metals. The two components may be separated in the roots but both can be transported to leaves. Chelating agents without metals often compete with roots and soil for metals and are generally not a good method of correcting micronutrient deficiencies. There are other interactions of soils, chelating agents, and micronutrients. Plant species differ greatly in their responses to chelated metals and some fail to respond.

U. Calif., Los Angeles, Calif.

Volobuyev, V. R. CHANGES IN THE CONTENT OF SILICA, ALUMINA, AND IRON IN SOILS IN RELATION TO HYDROTHERMAL CONDITIONS. Soviet Soil Sci. 5: 509-515. May 1962.

Data from total chemical analyses of soils of various countries of the world were selected and classified in order to study the pattern of change of the chemical composition of the mineral part of soils of the major genetic groups.

Construction of graphs of the frequency distribution of SiO_2 , Al_2O_3 , and Fe_2O_3 in the major large groups of soils (soil communities) made it possible to determine the limits of variation in the content of oxides in soils, to represent in a more concrete form the major characteristics of the chemical composition of the mineral part of soils of various groups, and to distinguish some patterns of its change from group to group.

The regular nature of the change in the composition of the mineral part of soils in relation to the hydrothermal conditions of soil formation was determined. Climate-composition graphs clearly showed the change in the SiO_2 , Al_2O_3 , and Fe_2O_3 content in relation to these conditions. The hydrothermal conditions under which both an extreme impoverishment of oxides and their intense accumulation occurred were determined along with conditions which were favorable to secondary clay formation.

Scripta Technica Inc., 1000 Vermont Ave., N. W. Washington, D.C. 20005

Koo, R. C. J. THE USE OF LEAF, FRUIT, AND SOIL ANALYSIS IN ESTIMATING POTASSIUM STATUS OF ORANGE TREES. Fla. State Hort. Soc. Proc. 75: 67-72. 1962.

Potash was omitted from a block of Hamlin and Valencia orange trees having a wide potassium range resulting from a previous experiment. The residual effects of previous treatments were measured by leaf, fruit, and soil analysis for 5 years. Little change in leaf potassium content and fruit production was noted in the first 2 years. Fruit production was affected as the potassium content from different treatments approached the critical level beginning the third year. At the end of the experiment, all plots were producing less fruit than the check plots, which received potash regularly.

A potassium content of 1.5 percent for Hamlin and 1.2 percent for Valencia was suggested as the critical level in leaves, above which level the potassium content should be maintained.

The relative application and limitations of leaf, fruit, and soil analyses for potash fertilization were discussed.

U. Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Boawn, L. C., Crawford, C. L., and Nelson, J. L. EVALUATION OF THE NITROGEN STATUS OF CORN BY TISSUE TESTS. U.S. Dept. Agr., Agr. Res. Serv., ARS 41-76, 11 pp. 1963.

Nitrogen tissue tests were made on field corn growing on plots having 60 different N levels. These tests were correlated with leaf N concentration at silking, total N uptake, and grain yield. The tests were made on the midrib of a leaf halfway up the stalk at tasseling, with alph-naphthylamine as a reagent.

A highly significant positive correlation ($r = 0.92$) was obtained between the tissue tests and leaf N concentration in the second leaf below the upper ear at silking. A maximum tissue test at tasseling was necessary in order to have a leaf N concentration at silking of at least 2.90 percent, which has been shown to be the "critical level" for this nutrient.

A highly significant positive correlation was obtained between tissue tests and total N uptake. Grain yields on previously uncropped ground, initially low in soil N, were positively correlated with the tissue tests, but on ground where a 3-year-old stand of alfalfa had been plowed down, high yields were obtained even though the tissue test was low at tasseling.

A distinct separation of the correlation data obtained from plots located on virgin ground and from plots located on old alfalfa ground indicated a difference in the N-supplying pattern of the two areas.

Plant-to-plant variation in tissue test ratings was found to be as great as fourfold under conditions of moderate or incipient N deficiency.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Stewart, B. A., and Porter, L. K. INABILITY OF THE KJELDAHL METHOD TO FULLY MEASURE INDIGENOUS FIXED AMMONIUM IN SOME SOILS. Soil Sci. Soc. Amer. Proc. 27: 41-43. 1963.

Some soils contain a form of indigenous fixed ammonium that is not removed by Kjeldahl procedures. This fixed ammonium was released by treatment with HF. A pretreatment of soil with HF should be considered when analyzing soils likely to contain significant amounts of indigenous fixed ammonium. The low values obtained by Kjeldahl procedures can result in serious errors when expressing the fixed ammonium as a percentage of the total N as is commonly done. The pretreatment of soil with HF is not believed necessary to remove ammonium fixed from added fertilizer N, but it is essential for removal of indigenous ammonium that probably completes with potassium for positions in the clay lattice at the time the clay is formed.

SWCRD, ARS, USDA, Fort Collins, Colo. 80522

Spurgeon, W. I., and Grissom, P. H. GREENHOUSE AND FIELD MEASUREMENTS OF NITROGEN LOSS FROM A SHARKEY CLAY SOIL AS INFLUENCED BY WATER-LOGGED SOIL, NITROGEN SOURCES AND PLACEMENT OF NITROGEN. Miss. State U. Agr. Expt. Sta. B. 668, 8 pp. 1963.

In a greenhouse test, a water-logged Sharkey c soil lost all (150 p.p.m.) of the applied nitrate nitrogen within a 16-day period.

A field experiment was conducted over a 4-year period to measure the influence of water-logged soil treatments, nitrogen sources, and placement of these sources upon the amount of nitrogen loss from a Sharkey c soil. The results of this experiment were:

1. Nitrogen loss each year, from the non-water-logged soil was proportional to the amount of rainfall and mean temperature for the duration (20 days) of the experiment. The amount of nitrogen lost was greatest for the periods with the most rainfall and highest mean temperature.
2. Nitrogen loss, each year, from the continuously water-logged soil was proportional to the mean temperature for the duration (20 days) of the experiment. The amount of nitrogen lost was greatest for those periods with the highest mean temperature.
3. The 4-year average (nitrogen sources and placement averaged) nitrogen loss over a 20-day period from the non-water-logged soil was 45 pounds per acre compared to 92 pounds from the water-logged soil.
4. More nitrogen was lost from ammonium sulfate than from sodium nitrate in the non-water-logged soil. More nitrogen was lost from sodium nitrate when the soil was maintained under a water-logged condition.
5. Nitrogen loss was less when the nitrogen was placed 4 inches under the soil as compared to a surface application regardless of the water-logged soil condition and/or nitrogen sources. The greatest amount of nitrogen lost (118 pounds per acre) was from the water-logged soil where sodium nitrate was surface applied.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Welch, C. D., and Bartholomew, W. V. RELATIONSHIPS BETWEEN $\text{NO}_3\text{-N}$ PRODUCTION, DRY-MATTER PRODUCTION AND N RESPONSES ON COASTAL PLAIN SOILS. Agron. J. 55: 441-443. 1963.

Dry-matter production of millet grown in greenhouse pots was found to be closely related to N uptake.

Nitrate-N production was significantly correlated with N uptake by millet from well-drained soils but not from poorly drained soils. Therefore, the current $\text{NO}_3\text{-N}$ production procedure appears to be a more suitable soil test for N in those Coastal Plain soils which are well drained.

Corn yields from field plot studies were related to the results of soil tests for N by regression analyses. Yields with no applied N were significantly correlated with $\text{NO}_3\text{-N}$ production but not with organic matter or Kjeldahl N. Yield response from N was also significantly correlated with $\text{NO}_3\text{-N}$ production but coefficients were larger for the group of well-drained than for the poorly drained soils. Soil conditions, such as drainage, should be considered when using soil tests for N as guides to N fertilization practices.

N. C. State Col., Raleigh, N.C.

Levesque, M., and Ketcheson, J. W. THE INFLUENCE OF VARIETY, SOIL TEMPERATURE, AND PHOSPHORUS FERTILIZER ON YIELD AND PHOSPHORUS UPTAKE BY ALFALFA. *Canad. J. Plant Sci.* 43: 355-360. 1963.

Du Puits and Ladak varieties of alfalfa were grown for 10 weeks in the greenhouse on soil-sand media controlled at temperatures of 10°, 18°, and 26° C. P-32-tagged superphosphate was applied at rates of 10 and 80 p.p.m. phosphorus, respectively. Dry-matter yields and phosphorus content of the tissue were determined at the end of the growth period. Increasing soil temperature from 10° to 26° C. caused corresponding increases in total phosphorus uptake as a result of an increase in dry-matter yields, as well as an increase in the percentage of phosphorus in the plant tissue. Ladak exhibited the higher yield potential although Du Puits was less affected by low soil temperature conditions and appeared capable of making better use of soil phosphorus. With the higher phosphorus application, the root-top ratio for Du Puits was greater than that for Ladak, and the maximum value for this ratio occurred at 18° C. for each variety. P-32 activity measured in the tissue indicated that soil temperature was critical in terms of phosphorus fertilization in the 4- and 6-week stages of growth.

Ontario Agr. Col., Guelph, Ontario, Canada.

Datta, N. P., and Goswami, N. N. EFFECT OF ORGANIC MATTER AND MOISTURE LEVELS ON THE UPTAKE AND UTILIZATION OF SOIL AND FERTILIZER PHOSPHORUS BY WHEAT. *J. Indian Soc. Soil Sci.* 10: 263-276. 1962.

Effect of three levels of organic matter (0, 10, and 20 tons of F.Y.M. per acre) and four levels of moisture (50, 75, 100, and 125 percent moisture equivalent of the soils) on the availability and uptake of soil and fertilizer phosphorus by wheat was studied on four Indian soils having quite different physical and chemical properties in pot culture and laboratory experiments by radiotracer technique. Yield, percent composition of phosphorus and uptake of total and soil phosphorus increased, while percent and actual uptake of fertilizer phosphorus decreased with the increase in organic matter levels. The effect on percent utilization of fertilizer phosphorus varied from soil to soil. Increase in moisture levels increased yield, percent composition of phosphorus, uptake of total, soil, and fertilizer phosphorus, and percent utilization of the added fertilizer. In both pot culture and laboratory studies, availability of phosphorus in the soil increased with increase in organic matter levels. Since there was no consistent effect of moisture levels on the availability of phosphorus in the soil, no general conclusion could be made. Significant interactions between organic matter and moisture were observed as regards uptake of total phosphorus, percent fertilizer phosphorus in the plant, and percent of utilization of the added fertilizer.

Indian Agr. Res. Inst., New Delhi, India.

DeDatta, S. K., Fox, R. L., and Sherman, G. D. AVAILABILITY OF FERTILIZER PHOSPHORUS IN THREE LATOSOLS OF HAWAII. *Agron. J.* 55: 311-313. 1963.

Most of the Hawaiian soils are acidic in nature and contain clay minerals and compounds that fix added phosphorus almost immediately. In the three Latosols studied, the mobilization and immobilization of added P varied greatly. Added P remaining in solution declined very rapidly in the Kapaa soils (Aluminous Humic Ferruginous Latosol) and less rapidly in the Molokai soils (Low Humic Latosol) and Pauwela soils (Humic Ferruginous

Latosol). Application of lime to acid soils, at various pH values and at different equilibration times, changed the pattern of P concentration and the aluminum status.

Short-term extraction of three levels of P from these soils by sudangrass (*Sorghum vulgare* var. *sudanense*) showed that P concentration and P yield in plants increased with P application. Higher rates of application increased P content in the plant, but, in general, did not change yield of dry matter. Concentration and yield of P were higher in unfertilized plants grown entirely on vermiculite culture than in plants transferred from vermiculite to soils for 5 days. It was possible that there was an actual loss of seed P as well as vermiculite P from the plant to the soil, or P may have moved from the upper parts of the plant into the newly developed roots. Chemical and radiochemical studies showed that less than 1 percent of the added P was utilized by the test crop.

The extractable soil P remaining in the soils, after harvest, increased with increased rates of P application.

U. Hawaii, Honolulu, Hawaii.

Taylor, A. W., Gurney, E. L., and Lehr, J. R. DECAY OF PHOSPHATE FERTILIZER REACTION PRODUCTS IN AN ACID SOIL. *Soil Sci. Soc. Amer. Proc.* 27: 145-148. 1963.

Complex iron and aluminum phosphates that may be formed by the reaction of concentrated acidic phosphate solutions with soil minerals were incubated in a moist acid soil for 10 months. Potassium ferric phosphate, $\text{H}_8\text{KFe}_3(\text{PO}_4)_6 \cdot 6\text{H}_2\text{O}$, and calcium ferric phosphate, $\text{H}_4\text{CaFe}_2(\text{PO}_4)_4 \cdot 5\text{H}_2\text{O}$, dissolved incongruently with release of part of their phosphate to the soil and formation of strengitic residues. Potassium taranakite, $\text{H}_6\text{K}_3\text{Al}_5(\text{PO}_4)_8 \cdot 18\text{H}_2\text{O}$, was more stable; it persisted throughout the incubation period and released smaller amounts of phosphate. Amorphous iron and aluminum phosphates also persisted throughout the incubation period, and their rates of dissolution appeared to be controlled by the rate of diffusion of their phosphate into the surrounding soil.

TVA, Wilson Dam, Ala.

Volk, V. V., and McLean, E. O. THE FATE OF APPLIED PHOSPHORUS IN FOUR OHIO SOILS. *Soil Sci. Soc. Amer. Proc.* 27: 53-58. 1963.

Four acid soils (Ashtabula, Miami, Wooster, and Licking) were selected on the basis of the level of available P and the magnitude of P fixing capacity (ability to retain soluble P against Bray P_1 extracting solution). Water-soluble P labeled with P-32 was applied at the rate of 3.4, 29.2, and 106 p.p.m. parts of soil with and without additions of lime. The availability of the soil P to oats in the greenhouse was computed. Fractionation of the phosphate compounds, formed in the soil, was made.

Both the initial level of available P and the P-fixing capacity were found to be important in determining the amount of plant response to applied P. A value index of available P generally increased with rate of application of P and lime. The application of soluble P to soils high in P-fixing capacity decreased the availability (Bray P_1 extractability) of the native P, while the added P tended to increase the availability of the native P in the low fixing soils. Almost all of the applied P was recovered in the Al and Fe phosphate components. There was a tendency for recovery of more than half of the applied P as FePO_4 in the soils of high P fixing capacity and more than half as AlPO_4 in those of low fixing capacity.

Jr. Author, Ohio Agr. Expt. Sta., Wooster, Ohio.

Okuda, A., and Kawasaki, T. FIXATION AND RELEASE OF PHOSPHATE BY AND FROM SOILS. *Soil Sci. and Plant Nutr.* 8(6): 1-8. 1963.

The availability of phosphatic fertilizers applied to soil may be governed by the fixation of phosphate to soil and the release of phosphate fixed to soil.

The fixation and release of phosphate by and from soils, using mono-calcium phosphate, mono-ammonium phosphate, and di-ammonium phosphate labeled with radioactive phosphorus were studied. The authors concluded that:

1. The amounts of phosphate fixed by soils from mono-ammonium phosphate and di-ammonium phosphate were less than from mono-calcium phosphate.
2. When the soil was extracted with water, the amount of phosphate released from soil, which had been treated with di-ammonium phosphate, was more than that of mono-calcium phosphate, and that of mono-ammonium phosphate was intermediate.
3. It was found by autoradiographic technique that the distances of movement of phosphate through soil column increased in the following order: mono-calcium phosphate < mono-ammonium phosphate < di-ammonium phosphate.

Kyoto U., Kyoto, Japan.

Richards, G. E., and McLean, E. O. POSTASSIUM FIXATION AND RELEASE BY CLAY MINERALS AND SOIL CLAYS ON WETTING AND DRYING. *Soil Sci.* 95: 308-314. 1963.

Exchangeable K was determined as a measure of fixation and release of the K added to several common clay minerals under the following moisture conditions: Suspension; air-dried; air-dried and rewet; oven-dried; and oven-dried and rewet. Kaolinite fixed little K, regardless of moisture condition. Vermiculite and Putnam (beidellitic) fixed little K in the suspension condition but relatively large amounts when dried. Exchangeable K in these two minerals remained relatively unchanged with rewetting after drying. Illite fixed considerable K under moist conditions, relatively more when dried, and still more when rewet. Bentonite fixed considerable K in suspension, released K on air-drying, gave the same value as for the suspension when oven-dried, and remained unchanged with rewetting following air- or oven-drying. Prochlorite fixed some K in suspension, fixed none on drying, but fixed considerable K on rewetting.

Similar studies with soil clays and mixtures of clay minerals showed that the soil clays fixed much more K on drying than corresponding mixtures on clay minerals. The computed values based on K fixation of the individual clay minerals and the amounts present in the mixtures agreed fairly well with the K fixation obtained for the mixtures. The effects of the individual clay minerals tended to be additive, with no apparent dominance of the effect of a particular clay. The complexity of the mixtures used, and the limited number of mixtures, made it difficult to detect the effect of each clay mineral present. It appeared that illite had a major effect on fixation when in suspension, while the fixation properties of vermiculite seemed to be most evident with oven-drying. The much greater fixation of K by the soil clays than the corresponding clay mineral mixture may be due to greater weathering (hence a shift of K equilibrium toward lower K and thus a greater K-fixation potential) of the soil clays than the mixtures of standard minerals. A preliminary study using Na tetraphenylboron to "weather" the minerals appeared to support this postulate.

J. Art 49-62, Ohio Agr. Expt. Sta., Ohio State U., Wooster, Ohio.

Page, A. L., Bingham, F. T., Ganje, T. J., and Garber, M. J. AVAILABILITY AND FIXATION OF ADDED POTASSIUM IN TWO CALIFORNIA SOILS WHEN CROPPED TO COTTON. Soil Sci. Soc. Amer. Proc. 27: 323-326. 1963.

Field studies demonstrated the occurrence of K deficiency in California cotton fields. Unusually high rates of K fertilizers were required to correct the deficiencies. A greenhouse and laboratory study demonstrated that fixation of the added K was the reason high K applications were required. Two soils from problem fields were treated with K at rates ranging from 0 to 400 p.p.m. K and cropped to cotton in the greenhouse. Response, as indicated by plant analyses, plant symptoms, and yields, was not obtained until the application rate equaled or exceeded 160 p.p.m. K. Exchange and Rb-fixation capacities of the soils after cropping showed a progressive decrease as a function of the added K. Disregarding the K removed by the crop and assuming the decrease in exchange capacities was due exclusively to K fixation, 63 to 75 percent of the added K was fixed. Laboratory studies demonstrated that soils in the moist state would fix up to 900 p.p.m. K against neutral salt removal. The effect of the added K on the Mg content of the cotton plant was reported.

U. Calif., Riverside, Calif.

Dowdy, R. H., and Hutcheson, T. B., Jr. EFFECT OF EXCHANGEABLE POTASSIUM LEVEL AND DRYING ON RELEASE AND FIXATION OF POTASSIUM BY SOILS AS RELATED TO CLAY MINERALOGY. Soil Sci. Soc. Amer. Proc. 27: 30-34. 1963.

The effect of exchangeable K level and drying over H_2SO_4 upon K release and fixation by six soil series was studied in the laboratory. Differences in behavior seemed to be related very closely to clay mineralogy of the soils. Illite appeared to be the source of K released by drying, whereas fixation at moisture levels higher than 4 percent was associated with vermiculite and fixation at lower moisture levels with montmorillonite.

Further evidence indicates the moist K equilibrium value of these soils to be 0.45 me. exchangeable K per 100 g. of soil. When exchangeable K values were above that level for field-moist samples, K was fixed on drying, whereas it was released when the initial K level was lower. The magnitude of release or fixation appeared to be directly related to the clay mineralogy.

U. Ky., Lexington, Ky.

Soil Biology

Stewart, B. A., Porter, L. K., and Johnson, D. D. IMMOBILIZATION AND MINERALIZATION OF NITROGEN IN SEVERAL ORGANIC FRACTIONS OF SOIL. Soil Sci. Soc. Amer. Proc. 27: 302-304. 1963.

Straw and N fertilizers were incubated in soil and changes in content of some organic N fractions were measured. Ammonia, nitrate N, and N in several organic fractions were determined to detect changes in the organic fractions which could be related to increases or decreases in the inorganic N.

Most of the N immobilized during incubation with soil and straw was found in the nondistillable acid-soluble N fraction of the hydrolysate. Although the nondistillable acid-soluble N fraction constituted only about one-half of the total organic N, studies using N-15 showed that about three times as much fertilizer N went into this fraction during immobilization as went into the distillable acid-soluble and acid-insoluble N fractions combined.

SWCRD, ARS, USDA, Fort Collins, Colo. 80522

Tarrant, R. F., and Miller, R. E. ACCUMULATION OF ORGANIC MATTER AND SOIL NITROGEN BENEATH A PLANTATION OF RED ALDER AND DOUGLAS-FIR. Soil Sci. Soc. Amer. Proc. 27: 231-234. 1963.

Soil nitrogen accumulation beneath a plantation of red alder and Douglas-fir was compared with that under a pure fir segment of the same 30-year-old stand on the Wind River Experimental Forest in southwestern Washington.

Beneath the mixed plantation, there were significantly greater amounts of nitrogen in the forest floor and in the upper 24 inches of the mineral soil. Organic matter content in the upper 12 inches of mineral soil was also greater and bulk density at 0 to 3 inches was significantly less. Beneath the alder-fir stand, the carbon-nitrogen ratio was less, both in the forest floor and at 0 to 3 inches.

There were 938 pounds more N per acre to a depth of 36 inches under the alder-fir plantation. Consequently, an average of 36 pounds more soil N per acre per year had accumulated beneath the mixed stand than under pure fir.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Wieringa, K. T. THE HUMINIFACTION [HUMIFICATION] OF HIGH-MOOR PEAT: I. CHANGES IN ION-EXCHANGE CAPACITY AND NITROGEN CONTENTS OF THE ORGANIC MATTER IN HIGH-MOOR PEAT. Plant and Soil. 18: 53-69. 1963.

Changes in ion-exchange capacity and N-content of the organic matter occurred when high-moor peat was composted at room temperature. The ion-exchange capacity increased slowly.

Nitrogen was incorporated into the organic matter when the peat was composted with mineral fertilizers and N was applied as urea. The fixed nitrogen was not exchangeable with BaCl_2 or $\text{Al}_2(\text{SO}_4)_3$. It was assumed that micro-organisms played a part in this fixation.

Nitrogen losses occurred when, because of the nitrification process, the pH values dropped below 5.5.

Agr. U., Wageningen, The Netherlands.

Chao, T. T., and Kroontje, W. INORGANIC NITROGEN OXIDATIONS IN RELATION TO ASSOCIATED CHANGES IN FREE ENERGY. Soil Sci. Soc. Amer. Proc. 27: 44-47. 1963.

Free energy change of inorganic nitrogen oxidations in acid and basic media were calculated, interrelated, and used to interpret research data reported in the literature. The results were summarized as follows:

1. With respect to reactions involving nitrification, the data obtained were not always found to be in agreement with those reported in the literature. The primary reason for these deviations was that the pH of the medium had often been considered in formulating these reactions.
2. Hyponitrous acid may be one of the intermediate products in soil nitrification since the oxidation of either the ammonium ion or ammonia to hyponitrous acid is a thermodynamically spontaneous reaction.

3. Under alkaline conditions, nitrous oxide may be one of the intermediate products in soil nitrification, but it may be lost through volatilization.
4. In the nitrification process, hydroxylamine cannot exist as an intermediate between ammonia and/or ammonium ion and nitrite because the oxidation of NH_3 to NH_2OH in basic and of NH_4^+ to $\text{NH}_3 + \text{OH}^-$ in acid solution are nonspontaneous.
5. In acid solutions, nitrite will thermodynamically undergo three reactions: It may decompose to nitric oxide and nitrate; oxidize to nitrate; or be reduced to nitrous oxide. In alkaline solutions, nitrate seems to be the only product.
6. Under aerobic conditions, nitrous oxide may evolve from the decomposition of hyponitrous acid, and under anaerobic conditions, from the interaction of intermediate products, hydroxylamine, and nitrite.
7. Free nitrogen may evolve from reactions between nitrite and ammonium ion, urea, hydroxylamine, or amino acids.

Va. Polytech. Inst., Blacksburg, Va.

Walsh, L. M., and Murdock, J. T. RECOVERY OF FIXED AMMONIUM BY CORN IN GREENHOUSE STUDIES. Soil Sci. Soc. Amer. Proc. 27: 200-204. 1963.

The availability of native fixed NH_4 and applied NH_4 fixed in the A_p and B_1 horizons of a Dodge sil was investigated. In addition, the effect of freezing on the fixation of applied NH_4 was studied. By applying K and N to either the same or separate layers of soil in greenhouse pots, it was also possible to evaluate the effect of K on the release of fixed NH_4 . When NH_4 and K were applied in the same layer of soil, the A_p and B_1 horizons fixed 5 and 15 percent of the added NH_4 , respectively. An additional 5 percent of the added NH_4 was fixed in each horizon when the soil was frozen after applying NH_4 . However, when NH_4 and K were applied to separate layers of soil, negligible amounts of NH_4 were fixed. Highly significant correlations between exchangeable K in the moist soil after cropping and the amount of applied NH_4 fixed as measured by differential N uptake showed that the level of exchangeable K in the soil controlled the release of fixed NH_4 to the crop. Correlations between two methods of measuring fixation of applied NH_4 , namely, differential N uptake and analysis of the soil after cropping, were highly significant.

About 15 percent (0.12 me. per 100 g.) of the native fixed NH_4 in the B_1 horizon was released when the level of exchangeable K in the soil was very low. However, very little native fixed NH_4 was released from the A_p horizon, presumably because sufficient K remained in the soil of this horizon to block release of fixed NH_4 . These studies indicate that even under the most advantageous conditions very little of the native fixed NH_4 is available to crops.

U. Wis., Madison, Wis.

Boawn, L. C., Nelson, J. L., and Crawford, C. L. RESIDUAL NITROGEN FROM NH_4NO_3 FERTILIZER AND FROM ALFALFA PLOWED UNDER. Agron. J. 55: 231-235. 1963.

Evaluation of residual N from applications of NH_4NO_3 and the amount of N added to the soil by a 3-year-old stand of alfalfa were made by growing corn and determining total N uptake. The experiment was carried out on two adjacent areas simultaneously. One area had been cropped to alfalfa for 3 years and the other was virgin soil low in N.

In the first year after application, residual N from NH_4NO_3 , expressed in terms of the current season N application needed to produce the same N uptake, averaged 44 percent of the original application. Residual N after the second year was insignificant.

For the 5-year period that the plots were cropped, N uptake from the alfalfa area exceeded N uptake from the virgin area by 341 pounds per acre. Slightly less than half of this N was accounted for by spring growth, crowns, and surface trash plowed down. Over half was apparently in the alfalfa roots or had been added to the soil during the 3 years of growth.

During the first and second years of cropping, corn on the alfalfa ground produced over 100 bushels per acre without N fertilization, the N uptake being roughly equivalent to where 200 pounds N per acre had been applied to virgin soil.

SWCRD, ARS, USDA, Prosser, Wash. 99350

Mortensen, J. L. COMPLEXING OF METALS BY SOIL ORGANIC MATTER. Soil Sci. Soc. Amer. Proc. 27: 179-186. 1963.

Soil organic matter forms complexes with metals by ion-exchange, surface absorption, and chelation-reaction mechanisms. Complex coagulation and peptization reactions take place between organic matter and insoluble minerals. Little is known concerning the ligands in polymeric components of soil organic matter which chelate metals, but carboxyl, hydroxy, and amide groups are probably involved. These ligands could be present in polymers or mixtures of polymers of lignin, polysaccharides, tannins, and other polyphenols, proteins, and quinones.

A number of low molecular weight compounds such as amino acids, aliphatic acids, organic phosphates, and phenolics which are known to chelate metals have been separated from soil organic matter.

Practically all of the studies which have suggested that organic matter chelates metals have relied on circumstantial evidence. More work using radioactive tracers of metals and modern methods of extraction, separation, and identification of organic matter components will be required before the chemistry of complexing of metals by organic matter will be understood. Unequivocal evidence for chelation can only be obtained when the metallo-organic complex is completely identified and characterized.

Ohio Agr. Expt. Sta., Ohio State U., Wooster, Ohio.

Davey, C. B., and Papavizas, G. C. SAPROPHYTIC ACTIVITY OF RHIZOCTONIA AS AFFECTED BY THE CARBON-NITROGEN BALANCE OF CERTAIN ORGANIC SOIL AMENDMENTS. Soil Sci. Soc. Amer. Proc. 27: 164-167. 1963.

Carbon (C) from cellulose added to soil slightly suppressed the competitive saprophytic activity of Rhizoctonia, whereas nitrogen (N) from NH_4NO_3 increased it. Cellulose and NH_4NO_3 combined to produce a wide range of C/N ratios and incorporated in soil, suppressed Rhizoctonia activity at most C/N ratios. With certain exceptions, soil bacteria and fungi increased in numbers with decreasing C/N ratios. Soil streptomycetes were not greatly affected. Oat straw and soybean hay enriched with NH_4NO_3 suppressed Rhizoctonia activity at all C/N ratios tested. The cellulolytic fungus Humicola greatly increased in numbers in the presence of decomposing oat straw whereas Trichoderma was not affected.

CRD, ARS, USDA, Beltsville, Md.

Soil-Plant-Animal Relationships

Serr, E. F. NUTRITIONAL DEFICIENCIES IN CALIFORNIA WALNUTS. Calif. Agr. Expt. Sta. Ext. Serv. L. 137, 4 pp. 1961.

In California, many areas have shown varying degrees of deficiency in some of the essential elements for plant growth.

The nine elements known to be deficient in California walnut orchards in their approximate order of frequency and importance are: Nitrogen; zinc; boron; manganese; iron; potash; copper; phosphorus; and magnesium.

The deficiency symptoms were described and treatments suggested. Particular emphasis was given to nitrogen, as this is the one element most commonly deficient in California.

U. Calif., Davis, Calif.

Beardsley, D. W., McCormick, W. C., and Southwell, B. L. HYPOMAGNESEMIA AND GRASS TETANY IN CATTLE GRAZING TEMPORARY WINTER PASTURE. Ga. Agr. Expt. Sta. Mimeo. Ser. N. S. 165, 10 pp. 1963.

Grass tetany, a metabolic disorder in which nervousness, muscle twitching, and generalized muscle spasms appear to be the most prominent symptoms, has been observed in Georgia in lactating cattle grazing lush winter and spring pasture. Hypomagnesemia, or low blood serum magnesium, is a predisposing factor. The exact causes of this condition are not known, but one or more factors which may be involved are an agent in the diet or in the animal which ties up magnesium, stress of lactation, climatic stress, and an imbalance of certain minerals.

Immediate treatment of visibly affected animals with calcium and magnesium in glucose solution by a veterinarian was indicated. Increasing magnesium intake of the animal through supplements or drenches, applying magnesium to the soil as dolomitic limestone or in fertilizer, or dusting magnesium oxide on the forage immediately before grazing should reduce the incidence of grass tetany to a minimum. Feeding hay, ground snapped corn, or other feed supplements to cattle grazing oats or rye pasture also helped to reduce the problem.

Winter pastures of cereal grains are excellent sources of nutrients for all classes of livestock and were highly recommended. With proper attention to the possible problems which may be encountered with the use of these pastures for lactating cattle, there is no reason why the cattleman should not take advantage of the highly nutritious forage which can be produced from these crops.

Ga. Coastal Plains Sta., Tifton, Ga.

Hagstrom, G. R., and Berger, K. C. MOLYBDENUM STATUS OF THREE WISCONSIN SOILS AND ITS EFFECT ON FOUR LEGUME CROPS. Agron. J. 55: 399-401. 1963.

Several Wisconsin soils were found to be deficient in Mo for the growth of certain crops. Yields of red clover and soybeans were increased 65 and 80 percent, respectively, by the application of 2 pounds per acre of $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ as a fertilizer salt banded with the seed. Yields of lupines were increased approximately 75 percent by the application of a commercial Mo seed treatment preparation at the rate of 2 ounces per acre. Yields of canning peas were increased 35 percent by the application of 2 ounces per acre of $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ applied as a seed treatment.

Nodulation of soybeans and peas was considerably increased by applications of Mo.N content of soybeans and peas was also increased by applications of Mo.

Excessive plant Mo contents were found with the 2-pound sodium molybdate soil application, particularly when banded with lime.

U. Wis., Madison, Wis.

Allison, F. E., DeMar, W. H., and Smith, J. H. TOXICITY TO GARDEN PEAS OF CERTAIN FINELY-GROUND WOODS AND BARKS MIXED WITH SOIL. *Agron. J.* 55: 358-360. 1963.

The woods and barks of 28 species of trees were tested for toxicity to garden peas grown in limed soil-sawdust mixtures under conditions of adequate nitrogen. Cypress, redwood, red fir, white fir, shortleaf pine, sugar pine, longleaf pine, red oak, post oak, hickory, red gum, and chestnut showed no significant toxicity, either to germination or early growth, when used at rates of up to 8 percent by weight. Western larch, Eastern hemlock, Douglas fir, Engelman spruce, Western white pine, slash pine, lodgepole pine, black oak, white oak, and black walnut, tested at rates of 1 and 2 percent, were also nontoxic. California incense cedar wood and white pine bark were very toxic even at the 1 and 2 percent rates. The woods of red cedar, Ponderosa pine, and loblolly pine, and the barks of California incense cedar and yellow poplar were slightly toxic at either the 2 or 4 percent rates. The toxicity symptoms, observed on the first crop, were markedly decreased or entirely absent on a second crop of peas.

SWCRD, ARS, USDA, Beltsville, Md. 20705

Tucker, J. M., Cordy, D. R., Berry, L. J., Harvey, W. A., and Fuller, T. C. NITRATE POISONING IN LIVESTOCK. *Calif. Agr. Expt. Sta. Ext. Serv. C.* 506, 11 pp. 1961.

Nitrate accumulation in plants presents a potential danger to livestock which feed on them. Various factors can affect such accumulations, and different plants are known to be capable of accumulating nitrates in appreciable or even lethal amounts. Data from widely scattered sources were discussed, and plants known to accumulate nitrates were listed. Approaches to the control of losses from nitrate poisoning were suggested.

Calif. Agr. Expt. Sta. Ext. Serv., Davis, Calif.

Day, A. D., Dickson, A. D., and Tucker, T. C. EFFECTS OF CITY SEWAGE EFFLUENT ON GRAIN YIELD AND GRAIN AND MALT QUALITY OF FALL-SOWN, IRRIGATED BARLEY. *Agron. J.* 55: 317-318. 1963.

Experiments were conducted over a 2-year period (1957-58) to compare the grain yield, grain quality, and malt quality of two malting barley varieties (Atlas 54 and Hannchen) irrigated with sewage effluent with the yield and quality of the same two barleys irrigated with well water and fertilized with different amounts of commercial fertilizer.

Atlas 54 and Hannchen barleys produced 2,511 and 1,910 pounds of grain per acre, respectively, when irrigated with sewage effluent. Barley utilized efficiently the fertilizer elements in sewage effluent for high grain production.

Kernal weight, kernel size, and malt extract were decreased by the use of sewage effluent; but, in general, the percentage of nitrogen and malt diastatic power were increased.

Alpha-amylase activity was lower but beta-/alpha amylase ratios were higher when barley was irrigated with sewage effluent than when it received well water containing N, P, and K in amounts equivalent to those applied in the effluent.

Although sewage effluent produced high yields of barley grain, it tended to cause lower barley and malt quality.

Agr. Expt. Sta., U. Ariz., Tucson, Ariz.

Vittum, M. T. EFFECT OF FERTILIZERS ON THE QUALITY OF VEGETABLES. *Agron. J.* 55: 425-429. 1963.

Present technology has progressed to a point where certain recommendations can be made for varieties, soils, climates, and fertilizers that will produce high quality vegetables containing beneficial vitamins and minerals. Under our present marketing and distributing practices, however, premium prices are not necessarily paid for vegetables that contain high amounts of these components. Little incentive exists, therefore, for growers to add fertilizer merely to improve the nutritive value of their crops. Such nutritionally unessential factors as color, turgidity, shape, size, and freedom from defects largely determine what the housewife buys at the supermarket.

Such physical factors as cracking and hard core in tomatoes, tenderness or toughness of peas, pericarp in sweet corn, and fiber in beans are of considerable significance to the vegetable grower in marketing his produce. In general, differences in these physical factors are far more closely related to variety, climate, stage of maturity at harvest, and post-harvest handling procedures than they are to fertilization.

Although fertilizers can increase the nutritional value of vegetables, the average housewife is unwilling to pay a premium price for the vitamins, minerals, and other constituents involved, particularly since she has no way of knowing to what degree they are present. Fertilizers can control many such physical and biochemical factors as size, firmness, and color, which command the attention of the buyer.

The most obvious commercial effect of fertilizers on vegetable quality is correction of defects caused by mineral element deficiencies. A well-fertilized crop is a high-quality crop if an adapted variety is grown under good cultural practices on good soil, if it is harvested at a proper stage of maturity, and if it is handled properly in the distribution system which ends at the consumer's table.

N. Y. State Agr. Expt. Sta., Cornell U., Geneva, N. Y.

Gausman, H. W., and Estes, G. O. EFFECTS OF FACTORIALLY COMBINED LEVELS OF SULFUR AND MAGNESIUM ON POTATO PLANTS (SOLANUM TUBEROSUM). *Maine Agr. Expt. Sta. B. T5*, 25 pp. 1963.

Katahdin potatoes were grown in the greenhouse in 2-gallon crocks containing a virgin Caribou 1 soil. Factorially combined levels of S and Mg each at an equivalent rate of 0, 10, 20, and 30 lb./A. were imposed as treatments for the first five of seven crops. The sixth and seventh crops of potatoes were grown primarily to further deplete the soil of S and Mg

and to enhance or accentuate plant deficiency symptoms which occurred quite intensively during growth of the fifth crop of potatoes. It was concluded that:

1. Treatments with various amounts and combinations of S and Mg had no statistically significant influence on the pH of the virgin Caribou 1 soil even though leaching was prevented. There was significant but unexplainable variation between crops.
2. The soluble salt content of the soils progressively increased with cropping, due to additions of chemicals containing N, P, and K, but this effect was relatively the same for treatments with either S or Mg or their combinations.
3. Statistically, S and Mg treatments had no effect on maturity of potato plants as evaluated by comparing treatments in regard to days from planting to time of blossoming.
4. Treatments had a variable effect on plant height between crops. The interaction of Mg with S, however, was statistically significant for each of the first five crops. Considering all crops, the overall influence of S was to decrease plant height at all levels of Mg except the 20 lb./A. rate.
5. When data were considered for the first three crops, Mg additions of 20 and 30 lb./A. and S additions of 10 and 20 lb./A. produced the greatest number of tubers, approximately an additional four tubers per plant, and the results were statistically significant. When number of tubers per plant was considered for five crops, however, results were not statistically significant.
6. Sulfur and Mg treatments had no statistically significant effect on the dry weights of potato plants.
7. The regression of dry weight on nutrient content was studied for the first three crops. Magnesium and N were most important in the first crop, accounting for 54 percent of variation; PO_4 , Mg, and Cl accounted for 51 percent of the variation in the second crop; Ca, K, N, and Cl accounted for 78 percent of the variation for combined first and second crops, and N and Cl accounted for 80 percent of the variation for the combined first three crops.
8. Treatment effects on specific gravity were significant at the 10 percent probability level. This was primarily due to a cubic response which occurred when S was applied with 20 lb./A. Mg. Treatments consisting of 20 lb./A. Mg with either 0 or 20 lb./A. S resulted in a specific gravity of 1.086; while treatments of 20 lb./A. Mg with either 10 or 30 lb./A. S resulted in a specific gravity of 1.082.
9. Studies on the regression of specific gravity of potato tubers on nutritive contents of potato plants for the first four crops showed that Cl was by far the most important nutrient. The regression of specific gravity on Cl content accounted for approximately 70 percent of the total variation.
10. Increasing rates of S tended to decrease the uptake of N, Cl, and K. Mg treatments had a quadratic effect on contents of K and N, highest amounts occurring at 10 and 30 lb./A. Mg. Increasing rates of S did not have a linear effect on SO_4 content, but rather quadratic, with the highest contents occurring at the 0 and 20 lb./A. levels of S. Sulfur and Mg treatments had no statistically significant effect on cation to anion ratios.
11. Magnesium and Cl deficiency symptoms occurred on potato plants during the fifth cropping of the virgin Caribou 1 soil. A deficiency symptom due to a suspected Mg and Cl complex was described. The Mg and Mg and Cl complex deficiencies occurred with 0 and 10 lb./A. Mg in association with all levels of S. Cl deficiency was particularly intensive on plants grown without added S or Mg.

Box, J. E., Sletten, W. H., Kyle, J. H., and Pope, A. EFFECTS OF SOIL MOISTURE, TEMPERATURE, AND FERTILITY ON YIELD AND QUALITY OF IRRIGATED POTATOES IN THE SOUTHERN PLAINS. Agron. J. 55: 492-494. 1963.

Yield and quality responses were obtained to soil moisture treatment and soil temperature, but not to distance along the irrigation run or to fertilizer rates higher than 80-0-0.

Soil temperature appeared to override the influence of soil moisture at MIS (Mean Integrated Suction) values less than 1 bar in increasing yield and quality of tubers. Total tuber yield in the high moisture plots was reduced by 6.3 percent when the maximum daily soil temperature exceeded a mean maximum daily soil temperature of 71° F. and MIS increased from 0.37 to 0.57 bar. However, in 2 high moisture treatments, yield was not different when mean maximum daily soil temperature was 75° and 77° F. and the MIS were 0.57 and 0.88 bar, respectively.

Specific gravity was highest under conditions of high moisture supply and low fertility treatment.

SWCRD, ARS, USDA, Big Springs, Tex. 79721

Larsen, R. P., Kenworthy, A. L., Bell, H. K., and Gamble, S. J. EFFECTS OF POTASSIUM AND MAGNESIUM FERTILIZERS AND DOLOMITIC LIME ON THE NUTRITIONAL STATUS AND YIELD OF A CONCORD GRAPE VINEYARD. Mich. State U. Quar. B. 45: 376-386. 1963.

The effect of potassium and magnesium fertilizers and dolomitic lime on yield, soluble solids, petiole analysis, and soil analysis of a bearing Concord Vineyard, which was initially low in soil pH, potassium, calcium, and magnesium, were studied over a period of 5 years. Treatments were designed to study effects of no potassium versus high and low rates of K_2SO_4 and KCl with and without magnesium, applied as K_2SO_4 -- $MgSO_4$ and/or dolomitic lime.

There were no consistent significant differences between treatments for soil potassium or magnesium. Applications of potassium generally resulted in acceptable soil potassium values, whereas the non-treated checks remained relatively low in available potassium. Surface soil magnesium was increased significantly by lime, but not by K_2SO_4 -- $MgSO_4$. Subsoil tests appeared to more accurately reflect previous fertilizer applications than surface soil tests, but neither were considered reliable in reflecting the levels of potassium, calcium, or magnesium that were available to the vines.

There were significant differences in petiole potassium composition between fertilizer treatments during each year, but the values were near normal or in excess for all treatments and there was no indication that the non-treated checks were deficient in potassium, even after 7 years with no applications of potassium. There were no significant differences between treatments of K_2SO_4 and KCl.

Petiole magnesium was depressed by applications of potassium alone but was approximately the same as the non-treated check if magnesium was combined with the potassium (K_2SO_4 -- $MgSO_4$), and it was increased by lime. A highly significant negative correlation between petiole potassium and petiole magnesium, but no significant correlation between soil magnesium and petiole magnesium, indicated that the depressing effect of potassium on petiole magnesium was greater than the beneficial effects of magnesium applications.

Neither yield nor soluble solids were influenced significantly by the potash, magnesium, or lime treatments used.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

McNeal, F. H., Watson, C. A., and Kittams, H. A. EFFECTS OF DATES AND RATES OF NITROGEN FERTILIZATION ON THE QUALITY AND FIELD PERFORMANCE OF FIVE HARD RED SPRING WHEAT VARIETIES. *Agron. J.* 55: 470-472. 1963.

Three rates of N fertilizer were applied to five varieties of spring wheat at sowing and at flowering. Quality determinations were made by use of the farinograph and by baking composite samples of flour.

Differences were observed among the five varieties for each quality characteristic studied.

Rates of fertilizer application gave differences in flour protein, flour yield, absorption, valorimeter, and loaf volume.

Even though flour protein percentages were nearly the same from sowing and flowering applications of N fertilizer, valorimeter values were definitely inferior from the flowering application.

The data indicate that N fertilizer may change the quality of wheat but that the time of applying this fertilizer may be nearly as important to some quality characteristics as the amount applied.

CRD, ARS, USDA, Montana Agr. Expt. Sta., Bozeman, Mont.

Barker, A. V., and Bradfield, R. EFFECT OF POTASSIUM AND NITROGEN ON THE FREE AMINO ACID CONTENT OF CORN PLANTS. *Agron. J.* 55: 465-470. 1963.

Plant growth and nitrogen distribution in the amino acids of the soluble N fraction of 5-week old corn plants were studied in relation to several varying N and K quantities and ratios in nutrient solutions. Nutritional conditions limiting growth with both deficient and excessive amounts of N and K were produced. The effect of N deficiency and excess was the most limiting influence on growth. Generally, the growth of corn plants was greater with 75 percent of the N supply as NH_4^+ than with lower proportions of NH_4^+ .

Asparagine was the predominant amino acid in corn plants. Factors affecting the N status of the plants were best reflected by the asparagine content. Increasing the N supply and the proportion of N as NH_4^+ greatly raised the relative contents of asparagine. Increases in the relative proportions of asparagine were generally reflected in proportionate decreases in aspartic acid and glutamic acid and, in some cases, relative decreases in glutamine. Absolute glutamine contents were increased by raising the N concentration and proportion of NH_4^+ . Absolute aspartic acid contents showed increases with both increases in N and NH_4^+ , but glutamic acid showed consistent increases only with N increases. Higher concentrations of K up to 250 p.p.m. decreased the asparagine content in absolute and relative amounts at all N concentrations, except 10 p.p.m., and at all proportions of NH_4^+ . The total free amino acids decreased with K increases to 250 p.p.m. but returned to a high value at 500 p.p.m. K.

The results indicate that corn plants will make more growth on ammonium compounds than on nitrate compounds. This increased growth may be due to the fact that NH_4^+ ions were ready to be used in amino acid synthesis while NO_3^- utilization involves a high energy requirement for reduction to the NH_4^+ level. The uptake of NH_4^+ ions may have been favored over NO_3^- uptake at the near-neutral pH of these solutions. A high concentration of K was required when the amount of NH_4^+ -N in the nutrient solution was large.

Cornell U., Agr. Expt. Sta., Ithaca, N. Y.

Longenecker, D. E., and Lyerly, P. J. EFFECT OF IRRIGATION FREQUENCY AND RATE OF APPLIED SUPERPHOSPHATE ON ALFALFA HAY YIELDS AND QUALITY IN THE EL PASO VALLEY. Tex. Agr. Expt. Sta. Prog. Rpt. 2279, 7pp. 1963.

A combination fertility-irrigation test with Zia aphid-resistant alfalfa was conducted at Substation No. 17 in Texas during 1960-62. The test included three frequencies of irrigation water and three rates of applied superphosphate. Largest hay yields were obtained with the highest rates of applied phosphate and with frequent (14-day) irrigation.

Percent nitrogen and protein in hay were inversely related to irrigation frequency, with least frequent irrigation showing the highest N content. Hay from all treatments decreased in yield and quality during the summer. Percent phosphate in hay was related directly to the rate of applied superphosphate, but was unaffected by irrigation frequency.

Proper management was shown to be essential for profitable alfalfa production in the El Paso Valley. Several management aspects were discussed.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Soil Classification

Molthan, H. D., and Gray, F. A CHARACTERIZATION AND GENETIC STUDY OF TWO MODAL REDDISH PRAIRIE SOILS. Soil Sci. Amer. Proc. 27: 69-74. 1963.

The Zaneis and Kingfisher series were both developed from Permian "Red Bed" deposits and occur primarily in the Reddish Prairie Provinces of Oklahoma, Kansas, and Texas.

Four profiles of the Zaneis series and two profiles of the Kingfisher series were sampled in detail. Chemical and physical studies were made on each subhorizon. Clay mineralogical studies were made for each major horizon. The clay was separated into two fractions: 2 to 0.2μ and $<0.2\mu$. Ethylene glycol retention, nonexchangeable K, cation-exchange capacity, differential thermal, and X-ray diffraction analyses were made.

The clay fractions of all six profiles contained a high percentage of particles $<0.2\mu$ in diameter. Montmorillonitic-type minerals dominated the fine clays of all six profiles while illite, vermiculite, and kaolinite were dominant in the coarse clays. Very little evidence of weathering of clay minerals was found. The clay minerals present in the solum were, for the most part, inherited directly from the clay minerals present in the parent materials.

The parent materials of the Kingfisher soils were found to differ in character from those of the Zaneis. The soil materials of the Kingfisher soil appear to have been deposited in brackish water while those of the Zaneis were deposited in fresh water.

Jr. Author, Okla. State U., Stillwater, Okla.

Alexander, L. T., and Cady, J. G. GENESIS AND HARDENING OF LATERITE IN SOILS. U.S. Dept. Agr., Soil Conserv. Serv. Tech. B. 1282, 90 pp. 1962.

Laterite is a highly weathered material rich in secondary oxides of iron, aluminum, or both. It is nearly void of bases and primary silicates, but it may contain large amounts of quartz and kaolinite. It is either hard or capable of hardening on exposure to wetting and drying.

Interest in laterite developed among soil scientists and geologists because: It is common material; it is a hindrance to agriculture in many places; and some varieties have economic

value as iron and aluminum ore and as building material. Laterite is of theoretical interest because of its mode of formation; its potential as a stratigraphic marker; and as a possible indicator of past climate and physiography.

Laterite can be said to be an end product, or extreme example, of processes taking place over a large part of the earth's surface. True laterite itself interferes with land use in Africa, India, and elsewhere in the Tropics. The soil materials having some of the same characteristics, or which have been affected by some of the same processes, extend over most of the Tropics, and into large parts of the temperate zones. The weathering products of some of the basic and granitic rocks of the Piedmont of southeastern United States are indistinguishable from those of similar rocks in parts of Africa.

Although laterite itself is a problem to agriculture only in the Tropics, the process of weathering that lead toward a material like that from which laterite forms are widespread. The presence, appearance, and behavior of iron compounds in soils has been one of the most used, but least understood, criteria for classifying soils and studying their genesis. Iron compounds are a major cause of soil color; they affect soil structure; play a part in plant nutrition; and can be indicators of past and present conditions of weathering and drainage. The behavior of aluminum is of nearly equal importance and has been receiving much attention in recent years.

The field observations of laterite in West Africa made in 1951 by Technical Mission 47 of the Organization for European Economic Cooperation (OEEC) were given. The results of the physical, chemical, and mineralogical analyses, and the studies of the micromorphology of the samples collected by the mission were summarized.

This study has provided basic data about the origin, formation, and stability of the crystalline mineral forms of iron and aluminum oxides under natural subaerial conditions. The investigations have led to increased appreciation of the importance of amorphous and finely divided, or microcrystalline, materials. Amorphous substances are difficult to determine quantitatively, but we do know that--they are present in large quantities in some weathered materials; they can move and crystallize in a short time; and they are often associated as coatings with silicate clays. The study indicates that in some types of laterite hardening, only small changes in crystallinity in a small part of the total mass may be involved. This suggests that measures to prevent laterite formation, or even to reverse it, may be feasible.

SCS, USDA, Beltsville, Md. 20705.

Hogan, J. D., and Beatty, M. T. AGE AND PROPERTIES OF PEORIAN LOESS AND BURIED PALEOSOLS IN SOUTHWESTERN WISCONSIN. Soil Sci. Soc. Amer. Proc. 27: 345-350. 1963.

Seaton sil in southwestern Wisconsin was formed in the coarser textured windward portions of the same loess deposit as Fayet sil and Tama sil. This loess was as much as 19 feet thick on ridge crests and was underlain by two paleosols at some localities. The upper paleosol was a silt loam, which resembles Farmdale loess or silt both in morphology and in stratigraphy and which contains fragments of spruce charcoal with a radiocarbon age of $29,400 \pm 700$ years before present. The lower paleosol was truncated and the B horizons which remain were reddish clays underlain by dolomite. The dense uppermost B horizon contained 7.82 percent free Fe_2O_3 and the lower B possessed strongly developed fine angular blocky structure. Mass wasting occurred extensively on ridge flanks.

X-ray diffraction analyses showed that the silt loam upper paleosol was more highly weathered than the overlying calcareous loess, and the lower paleosol contained more vermiculite than residual clay derived from the same bedrock formation at other localities.

The radiocarbon data of the spruce charcoal were somewhat older than dates obtained from Farmdale deposits in Illinois or Iowa, and were older than ages of overlying loess calculated by G. H. Robinson from depth of carbonate leaching.

Jr. Author, U. Wis., Madison, Wis.

Aronow, S. LATE PLEISTOCENE GLACIAL DRAINAGE IN THE DEVILS LAKE REGION, NORTH DAKOTA. *Geol. Soc. Amer. B.* 74: 859-874. 1963.

The Devils Lake region of northeastern North Dakota is covered with glacial drift deposited by the Leeds lobe of the Mankato Substage of the Wisconsin Stage of the Pleistocene and is underlain by Pierre Shale of Cretaceous age. Associated with the Sheyenne River, which flows through the southern part of the region in a deep trench, are many stream terraces, spillways, deposits of ice-contact stratified drift, and eroded ground-moraine areas. Six stages of drainage have been established to which these various features were assigned. In the first two stages, the features formed as melt water drained to the glacial James River south of the region and as the ice front stood at and later retreated from the site of the Heimdal moraine, a recessional moraine of the Leeds lobe. The later stages occurred after the valley of the Sheyenne River was free of ice and after glacial Lake Souris northwest of the region drained down the valley to glacial Lake Agassiz in the eastern part of the State. Features originating during the four later stages were largely related to the deposition of the North Viking moraine (another, more northern, recessional moraine of the Leeds lobe) and subsequent retreat of the ice from the moraine. Discharge from the local Devils and Stump Lakes and from glacial Lake Souris were of considerable importance in the genesis of many features.

Lamar State Col. Tech., Beaumont, Tex.

Jha, P. P., and Cline, M. G. MORPHOLOGY AND GENESIS OF A SOL BRUN ACIDE WITH FRAGIPAN IN UNIFORM SILTY MATERIAL. *Soil Sci. Soc. Amer. Proc.* 27: 339-344. 1963.

The physical, chemical, and mineralogical data assembled indicated that physical phenomena were major factors involved in the development of genetic horizons of a Sol Brun Acide with a fragipan. Gross mineralogy was primarily inherited; chemical alteration was confined mainly to fine fractions in zones of maximum permeability above the fragipan and along connecting fracture planes. Compaction by glacial ice, periglacial phenomena, or weight of over-burden was not essential for development of density in fragipans. Density and firmness were attributed to reorganization of particles upon alternate dessication and wetting, possibly augmented by seasonal frost action and some illuviation of clay. Dessication was suggested as the major factor in development of polygonal fracture planes. Clay destruction by weathering was suggested as a major factor contributing to the character of zones of apparent eluviation. It was suggested that the fragipan was being degraded both from the top and from the fracture planes.

Jr. Author, Cornell U., Ithaca, N.Y.

Daniels, R. B., Rubin, M., and Simonson, G. H. ALLUVIAL CHRONOLOGY OF THE THOMPSON CREEK WATERSHED, HARRISON COUNTY, IOWA. Amer. J. Sci. 261: 473-487. 1963.

The Tazewell to Recent alluvium in the Thompson Creek Watershed, Harrison County, Iowa, is named the De Forest formation. Buried organic zones and unconformities within the formation permit division into the Soetmelk, Watkins, Hatcher, Mullenix, and Turton members.

Radiocarbon dates indicated that from about 14,000 years to sometime before 2,000 years ago, the Soetmelk and Watkins members were deposited, with only an apparent temporary pause about 11,000 years ago. Since about 2,000 years ago, three cycles of erosion and sedimentation have taken place. The last cycle started prior to 250 years ago and probably ended about the time the streams in the area started their present cycle of entrenchment.

SCS, USDA, and N.C. State Col., Raleigh, N.C.

McCracken, R. J., and Weed, S. B. PAN HORIZONS IN SOUTHEASTERN SOILS: MICRO-MORPHOLOGY AND ASSOCIATED CHEMICAL, MINERALOGICAL, AND PHYSICAL PROPERTIES. Soil Sci. Soc. Amer. Proc. 27: 330-334. 1963.

Certain Southeastern soils contain subsurface or subsoil horizons that differ from adjacent horizons by possession of one or more distinctive morphological features. Common terms for these are plow pan or traffic pan, brittle pan, organic pan, and fragipan. Results of micromorphologic studies of these pan types (claypans are excluded from this study) were reported, plus certain compositional characterization data to complement the thin section observations.

Brittle subsurface layers in the Norfolk soils were found to occur in two positions in the profile, immediately below the A_p horizon or plow layer and at or near the base of A_2 horizons. The former may be induced by implement pressure; the latter may occur at depths of 6 and more inches below the base of the A_p but within the A_2 or at A-B contact and seems to be pedogenic. The term "brittle layer" was used to describe the latter; "arenapan" was suggested as a name for these subsurface, coarse-textured brittle zones.

Organic pans, as they are called locally, are apparent humus B horizons of Ground-Water Podzols. Samples from the Leon soil were studied.

Fragipan development in the Southeastern United States is typified in the Grenada soil, formed from Southern Mississippi Valley loess. The fragipan in this soil occurred at the base of the B horizon, below a zone of slight clay accumulation.

The Leon B_h ("organic pan") and the brittle layers in the Norfolk A_2 horizon showed heterogeneous distribution of quartz sand separated by intergranular bridges of fine-grained material. These pan layers appear highly porous in thin section, though many pores appear to be blocked by intergranular bridges. The Norfolk "plow pan" or traffic pan at the base of the A_p horizon exhibited close packing of quartzose sand and clay plus silt, with some humus inclusions. The Grenada fragipan was a close-packed silty matrix containing a few areas of oriented clay and appreciable components of feldspar and mica.

A clay mineral species or complex of 14.7 Å basal spacing, expandable to 17 to 18 Å, with ethylene glycol solvation following treatment for removal of interlayer aluminum, appears to reach maximum concentrations in the pan layers of all profiles studied except Grenada. In the Grenada profile, there was a maximum relative concentration of this clay mineral immediately above the fragipan.

N.C. State Col., Raleigh, N.C.

Hugie, V. K., and Passey, H. B. CICADAS AND THEIR EFFECT UPON SOIL GENESIS IN CERTAIN SOILS IN SOUTHERN IDAHO, NORTHERN UTAH, AND NORTHEASTERN NEVADA. Soil Sci. Soc. Amer. Proc. 27: 78-82. 1963.

The occurrence, activity, and effect of Western species of cicadas on soil formation and their relationship to soil characteristics were studied on 70 semiarid rangeland soils. The distinctive soil structure of some Western soils was attributed to the burrowing of cicada nymphs and had been produced over a long period of time. Filled cicada nymph burrows were called "cicada krotovinas." Little mixing of soil horizons resulted from the activities of these insects.

A new type of blocky soil structure, "cylindrical," was proposed to describe cicada-induced soil structure.

Well-drained, moderately permeable, moderately deep and deep silt loam, Brown and Sierozem soils, formed in loess parent materials, were well suited to cicada nymph activity. Few cicada nymphs or krotovinas were observed in soils with coarse textures, fine textural B horizons, or high bulk density.

SCS, USDA, Salt Lake City, Utah.

Hutcheson, T. B., Jr. CHEMICAL AND MINERALOGICAL CHARACTERIZATION AND COMPARISON OF HAGERSTOWN AND MAURY SOIL SERIES. Soil Sci. Soc. Amer. Proc. 27: 74-78. 1963.

Maury and Hagerstown soil series have largely been differentiated in central Kentucky on the basis of phosphate level as determined by the chemical quick test in the field. Slight color differences were noted, but considerable overlap of this criterion exists. Field differentiation of these two series without chemical testing was difficult. Chemical and mineralogical data obtained for three Maury and two Hagerstown profiles point up the similarity between the two series as well as illustrate about as much range in many properties within the individual series as between them. These data suggest that as the soils occur in central Kentucky, differentiation at the series level was not justified.

U. Ky., Lexington, Ky.

Simonett, D., and Bauleke, M. P. MINERALOGY OF SOILS ON BASALT IN NORTH QUEENSLAND. Soil Sci. Soc. Amer. Proc. 27: 205-212. 1963.

Data from X-ray diffraction, elemental, differential thermal analyses, and differential dissolution were used to correlate the relationship between rainfall and clay mineral formation in the $<2\mu$ fraction of latosolic soils of North Queensland, Australia. Rainfall varied from 36 to 147 inches per year. Application of the weathering mean showed that the weathering intensity increased with increasing rainfall, being most pronounced in the surface layers. Poorly crystalline kaolinite was the dominant clay mineral (79 to 52 percent). Halloysite may be present in the higher rainfall areas. Total iron content moderately increased with rainfall from 12 to 20 percent. No positive evidence for allophane was found. Gibbsite content varied from 0 to 19 percent. The mineral composition of the silt fractions was estimated.

U. Kans., Lawrence, Kans.

Priest, T. W., Whiteside, E. P., and Heneberry, W. H. USE OF SOIL MANAGEMENT GROUPS AND RELATED INFORMATION IN EVALUATION OF FARMLANDS AND THEIR UTILIZATION. Soil Sci. Soc. Amer. Proc. 27: 335-339. 1963.

Soil management groups and related information were used in Eaton County, Mich., to arrive at equitable evaluations of farmlands. These values were then compared with values determined by assessors, another appraisal procedure, and with farmers' estimated land values. This method of farmland evaluation avoids the common tendency of assessors to overvalue low-valued properties. The computed land values averaged 112 percent of the other appraised values and averaged 97 percent of the farmers' estimated land values. Other uses of this method and the need for land classification in addition to soil classification were discussed.

SCS, USDA, Caldwell, Idaho.

Leven, A. A., and Dregne, H. E. PRODUCTIVITY OF ZUNI MOUNTAIN FOREST SOILS. N. Mex. Agr. Expt. Sta. B. 469, 30 pp. 1963.

The effect of parent material on the natural productivity of forest soils was studied in the greenhouse and laboratory. Eleven Zuni Mountain surface soils developed from shale, sandstone, limestone, and granite were included.

These soils differed widely in their nutrient supplying power. The order of their productivity, from highest to lowest, as indicated by barley growth in the greenhouse and by laboratory studies was mixed alluvium, shale, limestone, sandstone, and granite.

Nitrogen and phosphorus were deficient in these soils, and these fertilizers were needed for maximum plant growth. These soils appeared to contain an adequate amount of available potassium to produce normal plant growth. The nutrient content of the soils, as determined by chemical analyses, was positively correlated with greenhouse evaluation of the nutrient supply in the soils.

The quartz: feldspar ratio of the very fine sand fraction of these surface soils can be used to estimate the productivity of the soils. As the ratio of quartz to feldspar increased, the productivity of the soils decreased.

The quartz: feldspar ratio can also be used to estimate the relative degree of weathering of these soils. Generally, as the ratio of quartz to feldspar increased, the degree of weathering increased.

Volcanic ejecta were found in the very fine sand fraction of the A horizon of these soils. Interstratified clay minerals and amorphous materials composed the major portion of the minerals in the clay fraction. These minerals appear to have little influence on the productivity of the soils.

The fertility and permeability of the surface horizon and the effective depth of permeable soil were the major influences on the growth of ponderosa pine under field conditions. Soils with highly fertile, permeable A horizons and with deep, permeable profiles had higher timber productivity ratings than soils with less favorable conditions.

N. Mex. State U. Agr. Expt. Sta., University Park, N. Mex.

Stewart, E. H., Powell, D. P., and Hammond, L. C. MOISTURE CHARACTERISTICS OF SOME REPRESENTATIVE SOILS OF FLORIDA. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-63, 53 pp. 1963.

Efficient utilization and management of soil water for agricultural production requires basic information concerning the relationships between soil physical characteristics and soil

moisture. Effective flood control and subirrigation also require knowledge of the storage capacity and internal drainage characteristics of soils. In Florida, there is inadequate soil moisture information available to meet these requirements. Available data on physical and moisture retention properties of Florida soils were summarized as an aid in planning effective soil-water management.

A large percentage of Florida soils are sandy textured and have very low waterholding (retention) capacity. These sandy soils may have high water tables or relatively impervious layers that cause poor drainage and poor aeration after heavy rains. Information on the properties of these soils will be beneficial in designing drainage, irrigation, or flood control systems.

The soils described are representative of many of the well-established soil types of the State. They were grouped alphabetically in table form under their respective great soil groups.

Maps and Profile descriptions.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

EROSION CONTROL

Erosion Equation

Springer, D. K., Breinig, C. B., and Springer, M. E. PREDICTING SOIL LOSSES IN TENNESSEE. J. Soil and Water Conserv. 18: 157-158. *(SCS, USDA, Nashville, Tenn.)

Thoreson, A. S., and Maddy, J. K. USING THE SOIL LOSS EQUATION IN IOWA. J. Soil and Water Conserv. 18: 159-160. 1963. *(SCS, USDA, Des Moines, Iowa)

Longley, A. J., and Bondy, E. J. REDUCING SOIL LOSSES IN KANSAS. J. Soil and Water Conserv. 18: 160-161. 1963. *(SCS, USDA, Garden City, Kans.)

Improvements in equations for calculating soil loss have resulted in an equation, universal in adaptability, for use in areas wherever rainfall causes significant sheet erosion. The universal equation for predicting rainfall-erosion losses is being used increasingly east of the 98th meridian to improve conservation systems of farming. With appropriate adjustments for local conditions, it is applicable to all areas where soil loss because of rain is significant.

Soil losses by wind erosion are predicted by use of an equation that considers soil erodibility, climate, soil surface roughness, vegetative cover, and width of field.

It should be emphasized that these equations, valuable as they are, can be used only as a guide. They are not a substitute for judgement. The equations and their uses were explained in the three articles.

*Address of senior author given in parenthesis in citation.

Wind and Water Erosion

Horning, T. R. CLODDY SEEDBEDS HALT EROSION. Pacific Northwest Farm Quart. 86(6): 5. 1963.

An experiment was initiated near Weston, Oreg., in 1953 to investigate effects of seed-bed preparation on yield of wheat, erosion, and cost of tillage.

Treatments were as follows: (1) Plowed cloddy--seeded; (2) plowed cloddy--seedbed prepared--seeded; and (3) swept--seedbed prepared--seeded.

There was essentially no difference in yield between the plowed and swept treatments that were both worked to a fine seedbed; the plowed treatment yielded higher for 3 years and the swept treatment for 2 years, for averages of 49.5 and 49.1 bushels per acre, respectively.

Moderate runoff and erosion occurred during winter months on conventionally prepared seedbeds in 2 of the 5 years. No erosion or runoff occurred on cloddy seedbeds.

Although conventional seedbeds produced slightly higher yields than cloddy seedbeds, it was not economically feasible to do the extra tillage operations required to prepare a conventional seedbed. There was also the added benefit of erosion control during the high precipitation months on the land seeded in clods.

SWCRD, ARS, USDA, Pendleton, Oreg. 97801

Hendrickson, B. H., Barnett, A. P., and Beale, O. W. CONSERVATION METHODS FOR SOILS OF THE SOUTHERN PIEDMONT. U.S. Dept. Agr., Agr. Res. Serv., Agr. Inform. B. 269, 18 pp. 1962.

The southern Piedmont, an ancient plateau formation, includes the most severely eroded farming area of the Southeast.

About two-thirds of the 33 million acres consists of residual soils of the Cecil series, derived principally from massive granitic rocks.

Most southern Piedmont farms require establishment of intensive conservation practices if runoff and erosion are to be reduced and soil productivity increased and maintained. A land-use capability map should be used in developing these practices. Help in developing the farm plan is available from technicians and specialists of the Soil Conservation Service and the various State extension services.

Many soil and water management practices can be initiated and completed by the farmer alone. However, development of such practices as terracing, pond construction, drainage installations, and crop rotations should be planned and accomplished with the assistance of trained soil conservationists.

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Hendrickson, B. H., Barnett, A. P., Carreker, J. R., and Adams, W. E. RUNOFF AND EROSION CONTROL STUDIES ON CECIL SOIL IN THE SOUTHERN PIEDMONT. U.S. Dept. Agr. Res. Serv. Tech. B. 1281, 33 pp. 1963.

In the southern Piedmont problem area, much of the land slopes rather steeply, intense rainstorms occur frequently in the growing season, and intertilled row crops have long been grown on most of the cultivated land. Unless protective measures are taken, much of the 49-inch annual rainfall is lost as runoff and soil erosion continues at a high rate. Granitic soils greatly predominate. During the 15-year period 1940-54, a study was made on the Cecil soils, a representative granitic series, to determine how various cropping systems effect runoff and erosion on the different slopes.

Cecil surface soils are light to moderately heavy, the subsoils moderately permeable, the underlying materials rapidly permeable.

The southern Piedmont has a temperate climate. Winters are mild, and temperatures rarely exceeded 100° F. in summer. Precipitation is rather evenly distributed through the

year, with slight peaks in winter, early spring, and midsummer. Drought of rather serious consequences occurs, on an average, at least once a year, most frequently in the fall. Excessive-rate storms in the growing season average about nine a year.

Runoff and erosion were measured on 42 plots, all 20.74 feet wide and either 105, 70, or 35 feet long, on slopes of 3, 7, and 11 percent, respectively. (Plot lengths corresponded closely to the terrace spacings that were recommended for Southern Piedmont upland areas of these three degrees of slope when the project began.) Check plots were cropped continuously to cotton over the entire study period. Numerous crops and crop rotations were tested for their conservation value. Several methods of tillage were tested. Soil erosion, which occurred principally in the growing season, varied widely in severity from year to year. On the continuous-cotton plots it varied markedly according to steepness of slope. Highlights of the results were:

1. Plots on 7-percent-slope land 70 feet long in continuous cotton lost annually, on an average, 22 percent of rainfall as runoff and 20.5 tons per acre of soil. This annual soil loss represents removal of 6 inches of soil in 50 years.
2. In a 3-year rotation of oats-lespedeza, volunteer lespedeza, and cotton, the turned-under residues of the lespedeza and oats effectively reduced runoff and erosion during the following cotton year on 7-percent slopes.
3. Cotton grown in this rotation produced yields 35 percent higher than those of continuous cotton.
4. When maintained over two cycles, this rotation reduced both soil and water losses on 7-percent slopes to satisfactory levels.
5. Ripping rather than turning under lespedeza stubble on 7-percent-slope land in preparation for cotton resulted in slightly less loss of soil and water, but it lowered cotton yield when poor stands were obtained.
6. Stands of kudzu and sericea lespedeza that had become well established on 11-percent-slope land reduced annual runoff to less than 4 inches and soil loss to less than half a ton per acre. In the 2-year period they required to cover the ground fully, these crops permitted considerable runoff and erosion.
7. Increasing the slope length of cotton plots on 7-percent slopes to 70 instead of 35 feet only slightly increased the percentage of runoff but greatly increased the soil loss per acre.

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Hermsmeier, L. F., Meyer, L. D., Barnett, A. P., and Young, R. A. CONSTRUCTION AND OPERATION OF A 16-UNIT RAINULATOR. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-62, 136 pp. 1962.

The "rainulator" is a portable rainfall simulator developed to serve as a tool for runoff and erosion research. Runoff and erosion data obtained with rainulators supplement other data obtained from plot studies under natural rain to provide needed information for improved conservation farm planning.

The design and operation of the rainulator were described and illustrated.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Terracing

Beasley, R. P. A NEW METHOD OF TERRACING: THE VARIABLE-GRADE, VARIABLE-CUT TERRACE. Mo. Agr. Expt. Sta. B. 699(Rev.) 22 pp. 1963.

The extent that a terrace system can be improved by the variable grade, variable cut method of terracing will depend upon. (1) The irregularity of the topography, (2) the type of soil; (3) the type of equipment to be used in building the terraces; and (4) the amount of money to be spent on construction. On some fields, all the terraces can be made parallel. On others, only sections of terraces can be made parallel. In all fields, it will be possible to improve the layout by reducing the curvature of the terraces and by making sections of the terraces parallel, thereby reducing the size and number of irregular point row areas between them.

This proposed method of layout requires more thought and time than the layout of constant grade terraces. Construction of the terraces requires a change in technique and in some cases may cost more. The added convenience and the saving of time in farming these terraces will offset any increase in time or cost of layout and construction.

New techniques in the design, layout, and construction of variable-grade, variable-cut terraces were explained which will result in terraces with less curvature, more uniform spacing, and fewer point rows. A thorough knowledge of the principles and techniques involved is needed by the technician to plan and lay out the best possible terrace system.

U. Mo., Agr. Expt. Sta., Columbia, Mo.

Critical Areas

Woolhiser, D. A., and Miller, C. R. CASE HISTORIES OF GULLY CONTROL STRUCTURES IN SOUTHWESTERN WISCONSIN. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-60, 28 pp. 1963.

The construction of a gully control structure imposes an abrupt change in the conditions affecting sediment entrainment, transportation, and deposition. This change is superimposed upon a channel condition that is already unstable as evidenced by the existence of a gully. Because of the complex dynamic nature of the problem, design procedures for predicting stable channel gradients above and below these structures are highly subjective. Further complicating the possibility of predicting channel changes that will occur with structural control is the present limited knowledge of sediment transport phenomena in ephemeral streams.

The results of the initial part of a study of channel thalweg profiles above and below gully control structures were presented. This initial phase document gave present and past conditions and experiences at a number of selected sites as an aid to the engineer in the design of this type installation. It also illustrated certain items on which additional research is needed. Attention was primarily directed to the scour hole development at the principal spillway outlet and at channel thalweg development downstream.

The findings and conclusions are necessarily limited at this time to areas having channel and runoff characteristics similar to those found in southwestern Wisconsin. Additional research on gully control in this and other areas should result in the development of concepts and predicting techniques with broader application.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Haupt, H. F., and Kidd, W. J., Jr. LABORATORY METHODS FOR DETERMINING THE DOWNWARD MOVEMENT OF SEED ON ROAD FILLS. U.S. Forest Serv. Res. Note INT-2, 7 pp. 1963.

Several treatments tested under laboratory conditions were found to reduce the downward movement of broadcast seeds on the surface of a simulated road fill. Some general comments and recommendations were:

1. Because of inherent physical characteristics, hard, rounded seed of rye and yellow sweetclover were more apt to roll and slide downhill on road fills than the elongated, flat seed of intermediate wheatgrass and smooth brome grass.
2. Applying seed to: (1) A road fill pockmarked with shallow holes; (2) a wet road fill; or (3) applying wet seeds on a dry surface enhanced their retention after they fell. Treatment of holes on dry, crusted surfaces were superior to that on wet, soft road fills. The relative importance of these three treatments was more significant when hard, rounded seed were included in the mixture. When the surface holes were used as seed traps, the natural covering of seed with slough material protected the seed from wind, promoted faster germination, and improved the chances for survival.
3. Seeding upon a paper mulch or after an unchopped hay mulch was applied were the best methods tested for reducing the downhill movement of seed. Substantial numbers of seeds were trapped on the leaves and stems of the hay before they reached the soil surface.
4. When the hay was chopped and mixed with asphalt binder, considerably more seeds were trapped and readily held by the tacky binder. The Hydro-seeder effectively placed seed in contact with the ground surface when the application of dry seed after this form of mulch was in place.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Funk, D. T. A REVISED BIBLIOGRAPHY OF STRIP-MINE RECLAMATION. Central States Forest Expt. Sta. Misc. Release 35, 20 pp. 1962.

Nearly 100 references on strip-mine reclamation published since 1953 were given along with the more than 70 technical citations that appeared in Linstrom's original publication.

Central States Forest Expt. Sta., FS, USDA, Columbus, Ohio.

Seidel, K. W., and Brinkman, K. A. MIXED OR PURE WALNUT PLANTINGS ON STRIP-MINED LAND IN KANSAS? Central States Forest Expt. Sta. Tech. Paper 187, 10 pp. 1962.

Ten years after planting, pure stands of black walnut were found to have better survival, greater height, and better form than black walnut grown in mixture with black locust. In mixed stands without black locust, the black walnut grew almost as well as in pure stands. Mixed plantings were recommended because they usually result in earlier harvest of merchantable products and faster improvement of site.

Even when comprising only 25 percent of a mixture, black locust had a definite detrimental effect on black walnut. A 50 percent black locust component in the stand also reduced survival and growth of redcedar, green ash, bur oak, and sycamore.

Black walnut should be planted with bur oak, sycamore, redcedar, or green ash on spoil banks in southeastern Kansas.

Central States Forest Expt. Sta., FS, USDA, Columbus, Ohio.

SOIL MANAGEMENT

Cropping Practices

Cooper, C. S., and Eslick, R. F. INFLUENCE OF PASTURE TYPE AND MANAGEMENT PRACTICE UPON SUBSEQUENT BARLEY YIELD. *Agron. J.* 55: 429-431. 1963.

Yields of barley were measured in the year following 2 grazing trials and in the first and second year following a simulated grazing trial. The first grazing trial had originally evaluated the pasture performance of legumes, grass-legume mixtures, and grass only plus nitrogen. The second experiment had evaluated 3 grass-legume mixtures grazed under 2 rotation systems, and the third had evaluated performance of grass and legume forage species in response to 5 nitrogen and 4 irrigation regimes.

Barley yield increases following pasture were a reflection of the percentage legume previously present or of residual N from previous fertilization. Grazing management affected barley yield indirectly through its effect on legume composition.

Barley yields in the first experiment were significantly greater following stands of pure legumes than following grass-legume mixtures or grass fertilized with 300 pounds of N per acre. In the second experiment, yields were significantly affected by previous grazing system which influenced the amount of legume in mixture. In the third experiment, barley yields were: (1) Significantly greater following pure legumes than following grass previously fertilized with N rates varying from 0 to 400 pounds per acre; (2) not affected by previous N application of less than 200 pounds per acre; (3) less following Alta fescue and orchardgrass grown under low levels of N than following other grass species; (4) not affected by grass species when previously grown under N application of 100 or 200 pounds per acre; (5) significantly affected by grass species when previously grown under 400 pounds of N per acre; and (6) affected by previous irrigation treatment only when soils had previously been kept at or near field capacity.

The data emphasized the value of pasture legumes in terms of subsequent barley yields and the desirability of including subsequent crop yield evaluation in pasture-rotation planning and management.

CRD, ARS, USDA, Montana State Col., Bozeman, Mont.

Terrill, T. R., and Washko, J. B. FACTORS INFLUENCING SEEDLING ESTABLISHMENT OF GRASSES WITH AND WITHOUT ALFALFA IN TOBACCO ROTATIONS. *Pa. Agr. Expt. Sta. Prog. Rpt.* 246, 6 pp. 1963.

Each of four variables--date of seeding, companion crop use, fertilizer level, and choice of grass species--produced effects on the development of forage seedlings in a 3-year test conducted on tobacco land at Landisville, Pa. Capacity of alfalfa and grasses to overwinter,

botanical composition of resulting swards, and ultimate dry matter yields were influenced. Results of this investigation were:

1. Alfalfa and grass seedling size was significantly reduced by delay in the late-summer or fall seeding date.
2. Capacity of forage plants tested to overwinter was related to fall growth, but not directly proportional to seedling size.
3. Date 1, (last of August) the recommended late-summer seeding date for southeastern Pennsylvania, resulted in swards with the lowest weed percentages and the highest dry matter yields. However, the Date 2 (middle of September) plots yielded as much as the Date 1 plots when the companion crop was harvested for forage.
4. Late-summer forage seedings, made as late as 3 weeks after the recommended period, were superior to split seedings (grass in the fall, alfalfa overseeded in the spring) and spring seedings in 4-year tobacco rotations.
5. Presence of companion crops reduced seedling size of the associated forage species, and reduced weed contents of swards at time of first harvest.
6. Inclusion of companion crops decreased dry matter yields of forage species except under the extreme conditions of late seeding followed by cold, dry fall weather.
7. Timothy was more winter hardy than S-37 orchardgrass and more able to resist weed encroachment. S-37 orchardgrass recovered more rapidly after clipping and resulted in a better alfalfa-grass balance at the second and third harvest.
8. The high fertilizer rate, 700 pounds of 0-20-20 per acre, reduced fall alfalfa seedling size, but increased grass seedling size.
9. Fertilizer level had no significant effect on the winter survival of the forage seedlings, but did increase forage yields slightly.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Puhr, L. F. TWENTY YEARS OF SOIL MANAGEMENT ON A VIENNA SILT LOAM. S. Dak. Agr. Expt. Sta. B. 508, 32 pp. 1963.

The results of 20 years of soil management experiments on a Vienna sil in South Dakota were given. During the 20 years, soil fertility levels progressively declined with continuous cropping when no fertility maintenance practices were used. The need for fertility improvement practices increased with each successive year. Small grains gave more consistent responses to fertilizer treatments than corn. With the continued decline in fertility, response to fertilizer by corn is expected to be more consistent in the future.

The application of 40 lbs. of nitrogen per acre to corn and the application of 20 to 30 lbs. of nitrogen per acre to small grains produced maximum yields of crops in most years.

The application of 20 lbs. of phosphate (P_2O_5) per acre per year provided adequate available phosphorus for grain crops.

Subsurface tillage was a satisfactory tillage practice for providing protection to the soil and for conserving moisture, especially for the corn crop. The yields of corn, oats, and wheat on the subsurfaced plots compared very favorably with the yields obtained on the plowed plots. The use of fertilizer and manure with subsurface tillage was essential for securing optimum or satisfactory crop yields.

Plowing, with residues returned, produced more corn, oats, and wheat than where the residues were removed.

The tillage practices, which included plowing at depths of 4, 7, and 10 inches, subsurfacing with a blade, one way, or disk plowing and double disking, produced the following results: (1) For corn, 7 inches was the optimum depth of plowing; (2) subsurface tillage produced highest yields of corn when soil moisture was limited; and (3) the depth of tillage had less influence on yields of wheat when adequate fertility was provided.

Legumes, including alfalfa, red clover, and sweet clover, were valuable from the standpoint of adding or returning nitrogen to the soil. The problem of moisture depletion by these legumes seriously limited their use in areas with frequent summer droughts. Plowing earlier in the season helped to overcome this problem.

The use of legumes for fixation of nitrogen only was generally not profitable. Under special conditions such as protecting a soil from erosion, the retirement of land from production, and the payment for this practice made the use of legumes as a source of nitrogen only, economically profitable.

Continuous cropping with the same crop was successfully practiced for 20 years. The most significant soil changes were the loss of total nitrogen and the depletion of available soil phosphorus.

To secure optimum crop yields under continuous cropping required the use of fertilizer to maintain an adequate fertility level in the soil. In a corn-oats-wheat rotation, the return of crop residues was effective in reducing rates of nitrogen losses.

Tables and photographs.

Agr. Expt. Sta., S. Dak. State Col., Brookings, S. Dak.

Haworth, F. THE EFFECTS OF DIFFERENT PRIMARY CULTIVATIONS AND MANURIAL TREATMENTS ON THE YIELD OF EARLY PEAS, SPRING CABBAGE, LEEKS AND BRUSSELS SPROUTS. *J. Hort. Sci.* 38: 199-213. 1963.

The effects of different primary cultivations and manurial treatments on the yields of early peas, spring cabbage, leeks, and Brussels sprouts grown in rotation on a sandy loam soil were described. The cultivation treatments consisted of deep plowing, shallow plowing-with-subsoiling, shallow plowing, and shallow rotary cultivation, and these were combined factorially with three manurial treatments. Each of the crops in the rotation was grown in each year from 1954-59. Special attention was paid to weed control and the experimental area was kept essentially free from weeds.

The average differences between the yields from the three plowing treatments were small. Although the largest mean difference was only about 7 percent several of the differences were significant.

The plowing treatments gave significantly higher yields of all four crops than did shallow rotary cultivation; the mean difference varied from 11 percent for peas and Brussels sprouts to almost 40 percent for spring cabbage.

Farmyard manure with NPK mineral fertilizers gave substantially higher yields of leeks, spring cabbage, and Brussels sprouts than nitrogenous fertilizer alone, but a smaller increase of only 18 percent in the yield of peas.

The following significant interactions were discussed: cultivations X years, manurial treatments X years, cultivations X manurial treatments and, for leeks only, cultivation X manurial treatments X years. It was concluded that the effects of some of the experimental treatments on the water available to the plant roots were, at least in part, responsible for some of the significant differences and interactions.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, England.

Raleigh, S. M., Flanagan, T. R., and Veatch, C. LIFE HISTORY STUDIES AS RELATED TO WEED CONTROL IN THE NORTHEAST: IV. QUACKGRASS. R. I. Agr. Expt. Sta. B. 365, 10 pp. 1962.

Life history studies of quackgrass in a cooperative experiment by the experiment stations of Vermont, West Virginia, and Pennsylvania demonstrated much variation in plant growth and seed production. Some quackgrass seeds planted $1\frac{1}{2}$ inches deep in the field germinated and emerged, while many of those planted deeper, germinated but did not emerge from the soil. The length of rhizone sections influenced the depth from which quackgrass established new growth. An individual quackgrass plant produced more than 458 feet of rhizomes in one season. The presence of two toxic compounds in quackgrass rhizomes was demonstrated.

Agr. Expt. Sta., U. R. I., Kingston, R. I.

Wiese, A. F., Davis, R. G., and Smith, J. P. FENAC AND TRITAC FOR CONTROL OF SMALL PATCHES OF FIELD BINDWEED AND TEXAS BLUEWEED. Tex. Agr. Expt. Sta. Prog. Rpt. 2269, 3 pp. 1963.

Both liquid and dry formulations of tritac and fenac applied for the eradication of small patches of field bindweed and Texas blueweed gave control equal to or better than that obtained with comparable rates of TBA and PBA. The recommended rate of application for the two new herbicides was 20 pounds per acre.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Crop Residue Management

Chekalov, K. I., and Illyuviyeva, V. P. USE OF THE C14 ISOTOPE FOR THE STUDY OF THE DECOMPOSITION OF ORGANIC MATTER IN SOIL. Soviet Soil Sci. 5: 482-490. May 1962

C-14 was used to study the role of water-soluble organic substances in the formation of humic soil compounds. The authors concluded that:

1. The influence of individual fractions of organic matter extracted from clover and containing tagged C-14 on the formation of humic substances in two different podzolic soils was studied for 2 years under laboratory conditions.
2. Observations of C-14 and fractional analysis of the organic matter of soil at the beginning of the experiment, 10 days later, and 90 days later, showed that the influence of the water-soluble part of clover was not limited only to changes in the mobile forms of the organic matter of soil.
3. The radioactive carbon isotope added to soil with the water-soluble part of clover was found 10 days later in all the fractions of organic matter, even in the non-hydrolyzable soil residue. This indicated that the participation of the water-soluble part in the formation of humic soil compounds was associated with the development of biological processes. Thus, direct observations of C-14 demonstrated that the water-soluble compounds of organic matter take an active part in the formation of organic soil compounds which do not readily decompose.

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Tillage

Fanning, D. S., and Brady, N. C. AN EVALUATION OF THE PLOW-PLANT METHOD OF CORN PLANTING. Agron. J. 55: 348-351. 1963.

Field studies were conducted at two locations in New York in each of 2 years comparing the minimum tillage method (plow-plant) with the conventional tillage method for field corn (plowing and harrowing 3 times). At each location, comparisons were made with corn and with sod (alfalfa or bluegrass) as the preceding crop. Crop stands and yields, weed competition, nitrogen content of leaves, and soil porosity were used to evaluate the effects of the two methods.

Soil and climatic conditions determined the comparative performance of plants obtained by the two methods. Under conditions of good soil drainage, and or drier-than-normal early season moisture, the conventional method gave yields equal to or better than those from plow-planting. The conventional method also gave a much higher stand count and a higher yield on one portion of an experimental field that was exceptionally cloddy after plowing. Where the soil was somewhat poorly drained and/or the season wetter and cooler than normal, the plow-plant method gave superior yields to those obtained from the conventional method of tillage. Soil physical studies and nitrogen analyses of leaves supported the contention that the plow-plant procedure left the soil more porous and better aerated.

Jr. Author, N. Y. State Col. Agr., Cornell U., Ithaca, N.Y.

Mixon, A. C. EFFECTS OF DEEP TURNING AND NON-DIRTING CULTIVATION ON BUNCH AND RUNNER PEANUTS. Auburn U. Agr. Expt. Sta. B. 344, 15 pp. 1963.

Four-year results (1957-60) of contrasting land preparation (deep turning vs. surface mulching of organic debris) and cultivation treatments (non-dirting vs. dirting weed control) were reported for a bunch and a runner variety of peanuts in Alabama. The non-dirting method of weed control used herbicides before and after emergence of the peanuts.

With low incidence of stem and peg rot during the first 3 years, no major benefits except effective weed control were evident for deep coverage of organic matter and non-dirting weed control procedures. However, under a high level of incidence of stem and peg rot in 1960, deep turning together with non-dirting cultivation significantly decreased the numbers of dead and dying plants at harvest and increased the yield of pods of Early Runner and Virginia Bunch 67 by 48 percent and 31 percent, respectively, over the surface mulching--dirting treatments. The major benefit in disease reduction and yield increase was from deep coverage of organic debris.

The deep coverage of organic debris and non-dirting cultivation procedures suggested require little additional expense, as compared with conventional methods together with currently recommended chemical weed control practices.

Each year striking reductions in weed numbers were noted on the deeply turned plots.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Thorfinnson, T. S., and Epp, A. W. COST OF OPERATING TILLAGE AND HARVESTING MACHINERY IN NEBRASKA. Nebr. Agr. Expt. Sta. S. B. 475, 22 pp. 1963.

Studies of cost and performance of farm machinery have been outdated by rapid progress in machine technology. Current information is needed by farmers, county agents, and

research workers in related fields. Selected tillage, planting, and harvesting machines were studied in 1959-60.

The average annual cost per machine, per acre, per hour, and cost per acre at varying acres of use for most of the tillage, planting, and harvesting machines studied were given in table form. Machines in the southwestern Nebraska wheat area and machines in eastern and southcentral Nebraska were shown separately.

U. Nebr., Col. Agr., Agr. Expt. Sta., Lincoln, Nebr.

Fertility Requirements for Conservation Farming

Rohde, C. R. EFFECT OF NITROGEN FERTILIZATION ON YIELD, COMPONENTS OF YIELD, AND OTHER AGRONOMIC CHARACTERISTICS OF WINTER WHEAT. Agron. J. 55: 455-458. 1963.

Ten varieties of winter wheat were compared on nonfertilized summer fallow and on summer fallow receiving about 40 pounds of N per acre for a 9-year period. Data on grain yield and the components of grain yield were taken to determine whether varieties of wheat differed in the way these characteristics responded to N fertilization. Data were also taken on heading date, test weight, plant height, straw weight, and straw-grain ratio. The following results were obtained:

1. The average yield of grain was not the same every year. This was also true for each of the components of grain yield.
2. Year to year differences occurred in the ranking of this group of wheat varieties for yield of grain and for each component of grain yield.
3. N fertilization caused an increase in the grain yield and the number of culms produced by all varieties; however, none of the varieties showed a significant change in the calculated number of kernels per head. N fertilization caused a significant decrease in kernel weight of four varieties, while the other varieties showed no significant change.
4. Increases in grain yield associated with N fertilization were similar each year. Annual effects of fertilization on the components of yield were variable.
5. Recently developed varieties did not differ significantly from the older varieties in their yield response to N fertilizer.
6. Pastry varieties did not differ significantly from the bread varieties in their yield response to N fertilizer.
7. Individual yield components were not significantly correlated with grain yield. There was a highly significant negative correlation between number of culms and number of kernels per head.
8. The average effect of N fertilization on some other agronomic characteristics was as follows: 1-day delay in heading, although two varieties showed no effect; 0.7-pound-per-bushel increase in test weight, although two varieties showed no effect; 2- to 4-inch increase in plant height; 27.5 percent increase in straw weight; and three varieties showed an increase in straw-grain ratio, the other varieties did not show a significant effect.
9. The effect of N fertilization on the other agronomic characteristics studied was not the same every year.
10. The varieties did not rank the same every year for the agronomic characteristics studied.

ARS, USDA, Pendleton, Oreg.

Wells, J. P. EFFECTS OF TIMING OF NITROGEN FERTILIZATION OF RICE YIELDS.
Ark. Agr. Expt. Sta. Rpt. Ser. 112, 17 pp. 1962.

Studies were conducted in Arkansas over a 3-year period at the experiment stations at Stuttgart, Kelso, and Keiser, and on outlying farms in Arkansas County. They compared the effectiveness of single and split applications of nitrogen applied at various time intervals after seeding.

Single applications of nitrogen--Nato and Bluebonnet 50 rice were grown under continuous flood at the Stuttgart Station in 1959-60. Eight pounds per acre of urea nitrogen were applied in a single application to different plots at 10-day intervals. The yields reached a maximum 10 days later in the season in 1960 than 1959. Bluebonnet 50 rice produced a maximum yield of 103.4 bushels per acre when the nitrogen was applied 85 days after seeding, while Nato rice produced maximum yields when the nitrogen was applied 75 days after seeding. This yield of Nato was not significantly different from the 65-day treatment in either year. There was a sharp decline in yield when the nitrogen was delayed more than 10 days past the 75-day date. Late applications may have caused secondary tillering that resulted in later harvesting.

When plant population was low, an early application of fertilizer at 25 to 35 days after seeding or a split application was advisable.

On an outlying Arkansas County farm in 1960-61, anhydrous ammonia applied preplant was more effective in increasing rice yields than anhydrous ammonia bubbled in the water as topdressing. Topdressing at 60 to 75 days after seeding was superior to earlier anhydrous ammonia topdressing. Preplant anhydrous ammonia and urea and ammonium nitrate, applied at 70 days after seeding, were most effective in increasing yield. Potassium nitrate was inferior to the urea, ammonium nitrate, or preplant anhydrous ammonia.

In a 1960 test at the Kelso Station, Colusa and Calrose rice lodged so severely, even with no added nitrogen, that it was difficult to draw any conclusions. The Colusa showed a yield increase from 40 pounds per acre of nitrogen, but Calrose showed a decrease.

Application of nitrogen at different times influenced the yield of rice. The use of the number of days after seeding was inadequate in predicting the most advantageous time for applying nitrogenous fertilizers.

Split applications of nitrogen--When the nitrogen applications were split so that the nitrogen was applied at 35 and 60, 45 and 70, 55 and 80, or 65 and 75 days after seeding, the later the nitrogen was applied the more effectively it increased yields of Nato rice. This was not true, when the plant population was low. In 1960, when death of some of the plants resulted in a reduced stand, early nitrogen at about 35 days gave a large yield increase.

On Crowley sil at Stuttgart, a yield increase of Nato rice was obtained from up to 120 pounds per acre of nitrogen both in 1959 and 1960. At Keiser, on Sharkey c, there was no yield response of Nato when nitrogen was increased from 40 to 80 pounds per acre.

It made no difference in yield of rice in any of the tests whether the nitrogen was applied 1/2 and 1/2, 1/3 and 2/3, or 2/3 and 1/3 at the first and second applications on various dates.

Cultural practices may often dictate the time nitrogen should be applied. Effective grass control was obtained chemically at Stuttgart, while grass was not a severe problem at either Keiser or Kelso. No grass control was used in the outlying tests.

Agr. Expt. Sta. U. Ark., Fayetteville, Ark.

Morris, H. D., and Giddens, J. RESPONSE OF SEVERAL CROPS TO AMMONIUM AND NITRATE FORMS OF NITROGEN AS INFLUENCED BY SOIL FUMIGATION AND LIMING. Agron. J. 55: 372-374. 1963.

A greenhouse experiment was conducted to determine the effect of soil fumigation and liming on the relative efficiency on $(\text{NH}_4)_2\text{SO}_4$ and NaNO_3 as N sources for 6 crops grown

on Cecil cl soil. Plant weight, percent N in the oven-dry plant material, total N uptake, and plant height were the criteria used in evaluating the efficiency of the N sources.

A differential response to N source, fumigation, and liming was found among the six crops when plant weight was used as the criterion for evaluation. Tobacco was unable to utilize NH_4 satisfactorily on the unlimed, fumigated soil. Tomatoes utilized NO_3 more efficiently than NH_4 except on limed, nonfumigated soil. No significant difference between N sources was found with cotton, corn, grain sorghum, or Coastal bermudagrass.

Plant height and percent total N in the plant were not satisfactory criteria for evaluating N sources. A negative correlation was found between plant weight and percent total N in the plant material for all crops except Coastal bermudagrass.

When N uptake was used as the criterion, NO_3 was found to be significantly better than NH_4 in 13 out of 24 comparisons. The superiority of NO_3 was as marked on nonfumigated as on fumigated soil and more pronounced on limed than on unlimed soil.

Under normal conditions when the soil was adequately limed and not fumigated, either source of N appeared to be equally effective for crop growth.

U. Ga., Athens, Ga.

Drake, M., Colby, W. G., and Bredakis, E. YIELD OF ORCHARD GRASS AS INFLUENCED BY RATES OF NITROGEN AND HARVEST MANAGEMENT. Agron. J. 55: 361-362. 1963.

Management of an 8-year-old stand of orchardgrass adequately supplied with P and K, included two rates of N, early and normal dates of harvest, and 1.5- and 3-inch heights of cut. Both 3-inch height of cutting and early stage of growth at initial harvest were important factors in the seasonal production of orchardgrass, especially as related to yield response to fertilizer N. Yield increases were produced by early (25 percent headed) as compared to normal date (early bloom) and by 3-inch as compared to 1.5-inch height of cut. Response to time of cutting, height of cutting, and rate of nitrogen and the interaction between height of cut and time of cut, height of cut and rate of N, and time of cut and rate of N were highly significant. However, there was no yield response to N for the combination of normal date and 1.5-inch height of cut. Field observations indicated stage of growth for initial harvest (early) to be a more important factor than cutting height (3-inch) in the first harvest, but cutting height was more important in subsequent harvests. Growth of orchardgrass from plugs in the dark indicated greater carbohydrate reserve for high N, early cut, and 3-inch height of cut.

It appears that carbohydrate reserve as influenced by such management factors as stage of maturity at initial harvest, height of cutting and associated soil temperatures, and rate of fertilizer nitrogen applied may be the key factor to the rapid recovery by and high yields of orchardgrass.

Mass. Agr. Expt. Sta., U. Mass. Amherst, Mass.

Nordbo, M. T., and Miller, R. L. NITROGEN--COSTS OF APPLICATION. N. Dak. Agr. Expt. Sta. B. 441, 24 pp. 1963.

Bulk spreading of nitrogen fertilizer is relatively new and is rapidly expanding in eastern North Dakota. Increased fertilizer use and higher nitrogen rates per acre have stimulated need for bulk spreading. Nitrogen application rates in western North Dakota normally do not exceed the rate which can be applied safely and conveniently with the seed.

Nitrogen fertilizer is available in three basic forms: (1) Solid material, generally ammonium nitrate in a 33 percent available nitrogen concentration; (2) aqueous solutions which are non-pressure liquids with 28 and 32 percent available nitrogen, and (3) liquefied gases such as anhydrous ammonia containing 82 percent available nitrogen.

A farm operator considering bulk spreading of nitrogen may have all three types of material to select from. In addition to selecting the material, he must also decide whether to buy application equipment, rent the equipment, or custom hire the job done.

The costs of applying bulk ammonium nitrate by custom application, equipment rental, and machinery ownership were determined from a survey of all known dealers in eastern North Dakota. Ownership of a 3½ ton trailer spreader could not be justified economically for less than 1,000 acres of annual use when 60 pounds of nitrogen were applied per acre, providing rental equipment was available. If custom spreading was the only alternative to machinery ownership, over 450 acres of annual use were required to justify ownership economically.

Non-pressure liquid nitrogen also may be applied by owned equipment, rented equipment, or custom applied. A 30-foot sprayer of non-corrosive material and a 500-gallon nurse tank were assumed to be the most suited equipment. Ownership of this equipment could not be justified economically with less than 1,200 acres of annual use when rental equipment was available. Equipment ownership could be less costly with 360 acres of annual use if custom hiring was the only alternative to ownership.

Anhydrous ammonia users generally found application machinery ownership desirable because application is a relatively slow process. However, many dealers had rental equipment available and custom operators were available. Rental charges normally were based on the pounds of material applied. Annual use of over 270 acres was necessary for economic ownership of an applicator when applying 60 pounds of nitrogen per acre, providing rental equipment was available. When custom application was the only alternative to equipment ownership, 175 acres of annual use were needed to economically justify ownership.

Any individual farm operator should consider other factors such as: (1) Availability of material and equipment; (2) suitability of soil to type of fertilizer; (3) timeliness and speed of operation; (4) convenience; and (5) suitability to a particular farm operation.

The costs in this analysis were based on purchase of new equipment designed for the specific type of fertilizer. Individual farmers may reduce these costs by converting other equipment for fertilizer application. Used equipment may be available in some instances. Two or more farmers may buy one applicator in partnership to spread the ownership costs onto more acres. Some farmers may prefer to buy the equipment and do custom work for neighbors to reduce their unit costs.

Tables and graphs.

Agr. Expt. Sta., N. Dak. State U. Agr. and Appl. Sci., Fargo, N. Dak.

Potts, J. M. NEW ADVANCES IN LIQUID FERTILIZERS. *Fert. Solutions* 5(2): 18-21. 1963.

Use of liquid mixed fertilizers in the United States began 15 years ago on the Pacific Coast. By 1961-62, liquids accounted for about 29 percent of all the mixed fertilizer used in the Pacific area and about 6 percent of that used in the East North Central States. Today's average for the country as a whole is about 3.5 percent.

The continued growth of liquid or fluid types of mixed fertilizers may be attributed to the relatively low plant investment required, the increased availability of phosphoric acid in different parts of the country, and the ease with which the fertilizer can be

applied to the soil. Growth in some areas have been hampered by the relatively low nutrient content of the liquids.

How superphosphoric acid was used in the production of clear liquid fertilizers was given and the production and use of salt-suspension type fertilizers were discussed. The incorporation of micronutrients was discussed briefly.

TVA, Wilson Dam, Ala.

Hales, J. T. AIR APPLICATION OF LIQUID FERTILIZERS. Fert. Solutions 5(3): 20-23, 1963.

The use of agricultural airplanes is one more technique available to the grower to increase his yield per acre. Today, agricultural aircraft are widely used in the U.S. and throughout the world to apply fertilizers, seed, growth control chemicals, insecticides, herbicides, and fungicides.

Total land treated in 1960 for all phases of aerial application in the U.S. amounted to almost 52 million acres of which nearly 3 million acres were treated with dry and liquid fertilizers, according to the Federal Aviation Agency.

Liquid fertilizers applied by air to farm soils and crops or on grasslands for increased beef production showed a marked increase in 8 years from 174,000 gallons in 1952 to 2,717,000 gallons in 1960.

Rice was considered the most important crop fertilized by air. Growers in Arkansas, California, Louisiana, Mississippi, and Texas accounted for the majority of fertilized rice acreage treated from the air.

Most rice farmers use the airplane to apply materials to flooded fields. Considering time, an airplane can seed 500 acres or more a day compared to 50 to 75 acres by ground methods. By dropping already-sprouted seeds into flooded fields not navigable to ground rigs, aerial seeders add some 14 days to the growing season. Later in the season, airplanes apply fertilizer and weedkiller.

Transland Aircraft.

Vittum, M. T., and Hulburt, W. C. FERTILIZER PLACEMENT AND RATES FOR TOMATOES. N.Y. State Agr. Expt. Sta. (Geneva) B. 797, 20 pp. 1963.

Over a 5-year period, maximum yields of tomatoes were obtained in New York from applying most of the fertilizer on the plow sole, and applying 250 to 300 pounds per acre in bands with the transplanter. Minimum yields came from the two shallow placements--broadcast and disced in, and drilled in.

Yields increased with increasing rates of application of complete fertilizer.

Tomato growers in upstate New York should apply at least 1,500 pounds of a 6-18-6 fertilizer, or its equivalent. Approximately 1,200 pounds of this fertilizer should be placed either at the bottom of the plow furrow or should be broadcast and plowed under while the remainder should be applied in a band or bands with the transplanter.

N.Y. State Agr. Expt. Sta., Cornell U., Geneva, N.Y.

Mississippi Agricultural Experiment Station. CROP AND FERTILIZER RECOMMENDATIONS FOR MISSISSIPPI. Miss. Agr. Expt. Sta. B. 655, 24 pp. 1963.

Crop and fertilizer recommendations based on the latest research findings at State College and 10 Branch Experiment Stations in Mississippi were given. Information on fertilization, varieties, and rates of seeding for crops generally grown in Mississippi as well as information pertaining to lawns, turf grasses, and home gardens were included.

Because of varying soil and weather conditions and other local factors, no single crop variety or fertilizer will fit the entire state perfectly; nonetheless, these general recommendations are useful guides to crop production. These recommendations assume that other good farming practices will be followed.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Doll, E. C., Miller, H. F., and Todd, J. R. EFFECT OF PHOSPHORUS FERTILIZATION AND LIMING ON YIELD AND CHEMICAL COMPOSITION OF CORN, WHEAT, AND RED CLOVER. Ky. Agr. Expt. Sta. B. 682, 23 pp. 1963.

The effects of various rates of phosphorus applied at each of two rates of liming on the yields of corn, wheat, and red clover grown in a 3-year rotation were determined during 1946-59. Higher average yields of corn and wheat are obtained on plots limed to an average pH value of 6.6 than on those limed to pH 6.2, but rate of liming did not affect average yields of red clover. The pH tended to increase for 5 years after limestone was applied, but at the end of the experiment (12 years after liming) pH values tended to be from 0.3 to 0.5 unit lower than the first years after liming.

A marked response was obtained for phosphorus fertilizer throughout the experiment; statistical analyses of the average yields indicated that the most profitable rate of phosphorus was about 110 pounds of P_2O_5 per acre per rotation for corn, about 100 pounds for wheat, and about 200 pounds for red clover. Fixation of applied phosphorus was high on this soil, as indicated by the higher rate of phosphorus required for the most profitable average yield of red clover (all fertilizer phosphorus in the rotation was applied for corn and wheat) and by the comparatively low level of acid-soluble phosphorus in the soil as compared with the amount applied as fertilizer and that removed by cropping.

The results of this experiment, together with those of other Kentucky experiments, indicated that phosphorus fertilizer was used most efficiently when row or band placements were used. On soils very low in available phosphorus, row applications must be supplemented by broadcast applications for maximum yields.

U. Ky., Agr. Expt. Sta., Lexington, Ky.

Spencer, W. F. PHOSPHORUS FERTILIZATION OF CITRUS. Fla. Agr. Expt. Sta. B. 653, 48 pp. 1963.

Phosphorus rate experiments in bearing Valencia orange groves indicated no response to applied phosphorus during the first 3 years. Soil tests on samples from these groves indicated that soil test values above 22, 80, and 130 pounds phosphorus per acre by the acid ammonium acetate, the Bray P_1 , and Bray P_2 tests, respectively, would probably be adequate amounts of phosphorus for growth of citrus.

Phosphate applications improved growth of young trees growing on previously unfertilized Lakeland fs. No detrimental effects on either growth or root concentration occurred as a

result of normal rates of phosphorus applied to the young trees. Phosphorus, when used at recommended rates, had no effect on the amount of freeze injury to young trees.

Very heavy rates of phosphorus affected the quality of grapefruit. However, when phosphorus was applied at the normal rate of application of 120 pounds P_2O_5 per acre annually in the Valencia experiments, no detrimental effects of phosphorus on fruit quality were noted. The growth of rough lemon seedlings in pots and Pineapple orange trees in the field demonstrated that soil which received heavy rates of phosphate in combination with limestone were not toxic to the growth of citrus feeder roots. Best growth of both seedlings and budded trees occurred in soil from plots which had received either the high or medium rate of phosphate in combination with limestone.

The results of research on phosphate fertilization and the growth of citrus feeder roots led to the conclusion that the reported detrimental effects of phosphorus fertilization on root growth in field experiments were due to toxicity of copper mobilized or made more toxic by the acid phosphates.

Copper mobilization and consequent toxicity was not a very important factor in young trees planted on previously unfertilized soils low in copper where phosphates were added in relatively small amounts. No detrimental effects of phosphates were found when the phosphates were applied in the normal manner and at the usual rates of application to young trees on previously unfertilized soil.

The lack of response obtained to phosphorus applications on bearing Valencia trees during the first 3 years the experiments were conducted further substantiates the earlier finding that phosphorus accumulates in an available form in these soils and that it is possible to build up the phosphorus level so that continuous phosphorus applications are unnecessary.

U. Fla., Agr. Expt. Sta. Gainesville, Fla.

Neller, J. R. COMPARISONS OF PHOSPHORUS FERTILIZERS FOR PASTURES ON FLATWOODS SOILS IN FLORIDA. Fla. Agr. Expt. Sta. Tech. B. 651, 12 pp. 1963.

During 1952-58, an experiment performed on an area of newly cleared land of Leon fs soils of the flatwoods of north central Florida. Plots were limed, fertilized, and planted to Pensacola bahiagrass and inoculated Ladino clover seed. The phosphate of the fertilizer consisted of eight different treatments of rock phosphate, triple superphosphate, basic slag, and combinations of phosphates. Triple superphosphate and basic slag were applied at double the rates the first year to help insure the establishment of a stand of clover. Five cuttings were removed the first year and four in each of the subsequent years. No phosphates were added to the plots during the last year of the experiment except to one treatment to serve as a phosphate check with which to compare the residual effects of the other treatments.

Similar yields of forage were obtained from rock phosphate at the rate of 600 pounds P_2O_5 per acre, disked into the soil when the plots were planted, as from triple superphosphate applied yearly at the rate of 60 pounds P_2O_5 per acre, and from half as much rock phosphate supplement with triple superphosphate, top dressed at the rate of 30 pounds per acre annually.

Since most flatwoods soils are low in sulfur as well as in native phosphorus, a combination of rock phosphate and ordinary superphosphate supplied both phosphorus and the sulfur of gypsum needed to get clover-grass pastures well established. It was recommended that $\frac{1}{2}$ to 1 ton per acre of rock phosphate be disked into the soil before the pasture was planted and that a mixed fertilizer that contained ordinary superphosphate be applied at that time and annually thereafter.

Basic slag was a satisfactory source of phosphate in comparison with like amounts of P_2O_5 in superphosphate. Since basic slag contains very little sulfur, it must be supplemented with gypsum for clover pastures. The use of mixed fertilizers that contains the necessary sulfate, potash, and phosphorous were preferred when the minor element needs of the soils were satisfied.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Wright, B., Lancaster, J. D., and Anthony, J. L. AVAILABILITY OF PHOSPHORUS IN AMMONIATED ORDINARY SUPERPHOSPHATE. Miss. Agr. Expt. Sta. Tech. B. 52, 35 pp. 1963.

Forty-nine field experiments were carried out with cotton, corn, corn silage, wheat, and wheat forage at four separate locations over a 5-year period in Mississippi for the purpose of investigating the influence of five factors on the agronomic effectiveness of ammoniated ordinary superphosphate. These five factors were: (1) Degree of ammoniation; (2) size of the fertilizer granules; (3) source of non-ammoniating nitrogen; (4) ratio of N: P_2O_5 in the fertilizer; and (5) method of preparation. The phosphate fertilizers were banded and sufficient N and K_2O were applied to provide adequate and uniform amounts for all treatments. The results were expressed in terms of percent superphosphate equivalents calculated by fitting equations of the type $Y = a + b_1 \log x + b_2 (\log x)^2 + b_3 (\log x)^3$ (where Y = yield and x = lbs. of $P_2O_5/A.$ from superphosphate) to the averaged data for each different crop and then solving the equation for the pounds of superphosphate required to produce the yields equivalent to those given by the experimental fertilizers.

Of the factors studied, the degree of ammoniation was the most important in influencing the agronomic effectiveness of the phosphorus in ordinary superphosphate and excessive ammoniation drastically reduced the effectiveness of the phosphate. The percent superphosphate equivalents for ordinary superphosphate ammoniated to 0, 2.0, 4.1, 6.5, and 7.2 percent were 100, 85, 67, 39, and 28, respectively, when averaged for all crops, locations, and years.

Comparisons of the agronomic effectiveness, as revealed by these experiments with chemical analyses used for control purposes, showed that the present method used in the United States does not reflect the true agronomic value of ammoniated ordinary superphosphate in mixed fertilizers and does not provide a suitable basis for quality control. There was a close relationship between alkaline citrate "available" phosphorus and agronomic effectiveness. Solubility of the phosphorus in water according to the A.O.A.C. procedure was also closely correlated with agronomic effectiveness. A study of the phosphorus soluble in neutral ammonium citrate and in alkaline ammonium citrate revealed that the heavily ammoniated fertilizers contained relatively large quantities of phosphorus compounds more basic than dicalcium phosphate.

Data indicated that variations in granule size, source of non-ammoniating nitrogen, and N: P_2O_5 ratio in the fertilizer all had little effect of the availability of the phosphorus in ammoniated ordinary superphosphate. There was no difference in the efficiency of the phosphate in granulated fertilizers and in dry-mixed or mixed salt type materials.

Tables and charts.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Mulvaney, D. L. A NEW SOURCE OF PHOSPHORUS? LIQUID PHOSPHORIC ACID HAS BEEN AS EFFECTIVE AS DRY FERTILIZER ON PHOSPHORUS-DEFICIENT SOILS IN NORTHERN ILLINOIS. Ill. Res. 5(2): 5-6. 1963.

On the basis of 2 years' studies with wet process liquid phosphoric acid in Illinois, the following conclusions were drawn:

1. On soils that had tested low in phosphorus, corn and wheat yields were increased about as much by the liquid phosphoric acid as by dry superphosphate (0-45-0).
2. The residual or carryover effect of phosphoric acid, as measured by corn yields the year after application, was about like that of superphosphate.
3. Liquid phosphoric acid was effective whether applied in band or broadcast treatments.
4. Nitrogen and phosphorus needs were supplied in a once-over rapid operation, using liquid phosphoric acid and anhydrous ammonia.
5. Corn yields were not affected by the distance from the row at which liquid phosphoric acid was applied.

U. Ill., Col. Agr., Urbana, Ill.

Ahmed, I. U., Attoe, O. J., Engelbert, L. E., and Corey, R. B. FACTORS AFFECTING THE RATE OF RELEASE OF FERTILIZER FROM CAPSULES. Agron J. 55: 495-499. 1963.

A study was made to determine if fertilizer capsules could be made which would release their constituents gradually and in line with the needs of the plant. In greenhouse studies with corn grown on soil leached with 4 inches of water, 19-8-16 fertilizer capsuled with polyethylene film gave significant increases in yield and recovery of N and P by as much as 32, 66, and 30 percent respectively, over those of noncapsulated fertilizer, but no significant increases in recovery of K were obtained. Significant increases in recovery of all three elements were obtained in the case of the nonleached soils, but there were no significant increases in yield. In the field, the application of capsuled fertilizer for corn did not give significant increases in yield or recovery of N, P, and K over that of the noncapsuled fertilizer.

The rate of release of fertilizer from capsules in moist soil was directly related to temperature, number of pinholes per capsule, and vapor pressure lowering of water by the fertilizer and inversely related to the weight of the capsule. The rate of release was, for the most part, independent of cropping, soil texture, soil moisture between 25 to 100 percent field moisture capacity, and leaching. A highly significant coefficient of multiple correlation $R=0.96$ was found between the time required for water to accumulate in the capsule before being released and the weight of the fertilizer capsule and number of pinholes per capsule. A highly significant coefficient ($R=0.97$) was found between the amount of fertilizer released and the length of the released period, weight of fertilizer capsule, and number of pinholes per capsule. The data suggested that moisture entered the capsules through the pinholes primarily as vapor, dissolved the salt, and the saturated solution thus formed flowed out through the pinholes by gravity.

U. Wis., Madison, Wis.

Walker, C. F., and Williams, W. A. RESPONSES OF ANNUAL-TYPE RANGE VEGETATION TO SULFUR FERTILIZATION. J. Range Mangt. 10: 64-69. 1963.

Various sources of nitrogen and sulfur were applied in the autumn and winter seasons to resident annual-range type vegetation. Combinations of sulfur and nitrogen materials

resulted in increased forage production over nitrogen applications alone. The increased yield due to sulfur fertilization occurred consistently in the annual grass component, with no perceptible response by the forbs. Superior competitive ability of the grass for sulfur per se does not explain their response, as the sulfur content of the forbs was equal to or greater than the grasses in all treatments. The nitrogen-sulfur ratio was affected by fertilization, being widened by nitrogen applications and narrowed by sulfur and nitrogen combinations. It was concluded that sulfur can be an important fertilizer element on annual-type range, and can enhance directly the growth of common annual-range grass species when their need for nitrogen is satisfied.

U. Calif., Davis, Calif.

Reisenaure, H. M. RELATIVE EFFICIENCY OF SEED-AND-SOIL-APPLIED
MOLYBDENUM FERTILIZER. Agron. J. 55: 459-460. 1963.

Seed and soil applications of Mo fertilizer were compared with peas growing on two Mo-responsive eastern Washington soils. Seed-applied Mo fertilizers produced significantly greater increases in vine N content and seed yields and were from 30 to 60 times more effective in supplying Mo to the plants than were equivalent soil treatments. Adequate Mo was supplied by slurry application of 1/4 to 1/2 ounce of sodium molybdate per acre to the seed.

Kearney Found. Soil Sci., U. Calif., Davis, Calif.

Ahlrichs, L. E., Hanson, R. G., and MacGregor, J. M. MOLYBDENUM EFFECT ON
ALFALFA GROWN ON THIRTEEN MINNESOTA SOILS IN THE GREENHOUSE.
Agron. J. 55: 484-486. 1963.

Molybdenum and liming studies were made on 13 southeastern Minnesota soils with an initial pH range of 5.5 to 6.4. The Mo was applied at rates of 1 and 2 pounds per acre and CaCO₃ was added to a calculated pH of 7.

Three cuttings of Vernal alfalfa were obtained from 11 of the 13 soils. The possible need for Mo fertilization was considered as to: (1) Increased alfalfa yields; (2) percentage and total production of protein; (3) concentrations of Mo in dried alfalfa hay; and (4) total uptake of Mo from the experimental soils.

Both liming and Mo treatments increased Mo concentrations and total uptake in the alfalfa, but did not noticeably affect alfalfa yield, protein content, or production on any of the 13 soils. Mo concentrations in alfalfa grown on some Mo-treated soils were relatively high and could be toxic for livestock.

It was concluded that Mo fertilization of these soils was not essential for good alfalfa production at this time. Presently recommended soil liming practices should substantially increase the Mo content of Vernal alfalfa.

Southern Sch. Agr., Waseca, Minn.

Fireman, M. and Branson, R. L., GYPSUM AND OTHER CHEMICAL AMENDMENTS FOR
SOIL IMPROVEMENT. Calif. Agr. Expt. Sta. Ext. Serv. L 149, 4 pp. 1962.

This leaflet was designed to provide an explanation for the following: (1) How to determine whether a chemical amendment will improve a certain soil; (2) if needed, what amendment should be used; (3) how to determine the amount to use; (4) how to apply it; and (5) how it improves the soil.

Calif. Agr. Expt. Sta. Ext. Serv., Davis, Calif.

Hardy, G. W., Keogh, J. L., and Maples, R. LIMING ACID SOILS INCREASES SOYBEAN YIELDS. Ark. Farm. Res. 12(1): 2. 1963.

This test was conducted in Lonoke County, Ark., on Stuttgart sil. Three levels of fertilization were used in both a limed and no lime series of treatments, in which the limestone was applied broadcast. A finely divided limestone was used for all limestone treatments since application was made only 40 days before planting. In another treatment, $\frac{1}{2}$ ton of limestone to the acre was banded. A uniform application of 0-24-24 was banded at planting. Additional fertilizer and banded limestone were applied a few inches to the side of the row after plant emergence. Lime and fertilizer rates, and yields, are given in the table.

Response of Soybeans to Lime and Fertilizer Applications, 1962

Lb per acre of applied N-P ₂ O ₅ -K ₂ O	Tons lime ap- plied per acre April 25, 1962	Average yield (bu. per acre) from 8 replications	pH in December, 1962
0-24 -24	0	16.1	4.8
0-24 -24	4, broadcast	26.5	6.1
0-64 -64	0	21.9	4.6
0-64 -64	4, broadcast	29.7	6.1
0-124-124	0	22.3	4.8
0-124-124	4, broadcast	31.3	6.2
0-64 -64	$\frac{1}{2}$, banded	17.5	4.9
L.S.D. at 5% level		3.5	

There was no response to the banded application of limestone. This would indicate that calcium deficiency was not the problem overcome by liming this soil.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

Planning Committee. NATIONAL SYMPOSIUM ON POULTRY INDUSTRY WASTE MANAGEMENT. May 13-15, 1963. Nebr. Cent. for Continuing Ed., U. Nebr., Lincoln, Nebr. pp. not numbered. 1963.

The following papers were presented at the Symposium:

Jenkins, W. R. OBJECTIVES OF THE CONFERENCE. FES, USDA, Washington, D.C. 20250.

Dunk, M. R. THE TIME IS NOW. Ed. Poultry Tribune, Mount Morris, Ill.

Ostrander, C. E. WASTE MANAGEMENT ON THE FARM. Ext. Serv., Cornell U., Ithaca, N.Y.

Taggart, J. I. BURN IT. Chick Masters Incubator Co., 3212 West 25th Street, Cleveland 9, Ohio.

Hart, S. A. FARM FECAL FACTS. U. Calif., Davis, Calif.

Eby, H. J. MANURE DISPOSAL LAGOONS. AERD, ARS, USDA, Beltsville, Md. 20705.

Adams, J. L. INDOOR "LAGOONS" FOR POULTRY MANURE WASTES. U. Nebr., Lincoln, Nebr.

Wiley, J. S. UTILIZATION AND DISPOSAL OF POULTRY MANURE. USPHS, HEW, San Francisco, Calif.

- Taiganides, E. P. DIGESTION OF FARM POULTRY WASTES. Iowa State U., Ames, Iowa.
- Davis, H. R., and Sobel, A. T. PROGRESS REPORT ON MANURE HARVESTING. Cornell U., Ithaca, N.Y.
- Ludington, D. C. DEHYDRATION AND INCINERATION OF POULTRY MANURE. Cornell U., Ithaca, N.Y.
- Anderson, M. S. POULTRY PROCESSING FACTS. SWCRD, ARS, USDA, (retired), Beltsville, Md. 20705.
- Dyal, R. S. AGRICULTURAL VALUE OF POULTRY MANURE. SWCRD, ARS, USDA, Beltsville, Md. 20705.
- Wright, C. V. ODORS AND AIR POLLUTION. USPHS, HEW, Kansas City, Mo.
- Willrich, T. L. WATER POLLUTION PREVENTION. Ext. Serv., Iowa State U., Ames, Iowa.
- Black, R. J. PUBLIC HEALTH ASPECTS OF POULTRY WASTE MANAGEMENT USPHS, HEW, Washington, D.C. 20250
- Black, R. J. SANITARY LANDFILLING OF POULTRY WASTES. USPHS, HEW, Washington, D.C. 20250.
- Jones, C. M. FLY CONTROL. ERD, ARS, USDA, Lincoln, Nebr.

For sale by John L. Skinner, Ext. Serv., U. Wis., Madison, Wis.

Dyal, R. S. AGRICULTURAL VALUE OF POULTRY MANURE IN NATIONAL SYMPOSIUM ON POULTRY INDUSTRY WASTE MANAGEMENT. May 13-15, 1963. Nebr. Cent. for Continuing Ed., U. Nebr. Lincoln, Nebr. 15 pp. 1963.

Vast quantities of poultry manure must be either used or disposed of each year. Although much is used for soil improvement, the supply greatly exceeds the demand.

Poultry manure is a low analysis fertilizer which often results in higher handling costs for needed crop nutrient requirements than comparable chemical fertilizers. However, the spreading of accumulations of solid manures on cropland is probably the most profitable disposal method, especially where land is available. Even if the value of the poultry manure merely equals the cost of application, its use as a fertilizer saves the cost of disposal. Disposal in a lagoon is being studied. The poultry producer should select the manure disposal system that will be to his economic advantage or provide desired relief from drudgery. Under certain local situations, it may be advantageous to market some; however, the drying and handling costs are high.

The agricultural value of this product is twofold--for its plant nutrient content and for its organic matter content. On soils of good tilth, probably the only value is that of the plant nutrient content. However, on soils of poor tilth, the manure has an added value as a soil conditioner because of its organic matter content. Because of the ever-increasing rate of reshaping the land with resultant problems of soil tilth, this latter value is an area that might be developed profitably for the poultry producer.

SWCRD, ARS, USDA, Beltsville, Md. 20705

Hart, S. A. FOWL FECAL FACTS IN NATIONAL SYMPOSIUM ON POULTRY INDUSTRY WASTE MANAGEMENT. May 13-15, 1963. Nebr. Cent. for Continuing Ed., U. Nebr., Lincoln, Nebr. 12 pp. 1963.

Volumetric, physical, biological, and chemical information were given for chicken manure.

U. Calif., Davis, Calif.

Hartman, R. C. COMPOSTING CONTROLS FLIES. *Pacific Poultryman* 69(2): 18-19, 58-59. Feb. 1963.

The Prohoroff Ranch at San Marcos, Calif., has about a half million laying hens. The system used on this ranch was reported where the common house fly was partially controlled by composting the manure. About three-fourths of the composting occurred under the cages. With this system the manure odors have been virtually eliminated.

When the manure is removed from below the cages, it is transferred to another area to complete the composting process. It is spread out to a depth of 3 to 4 feet, then sprinkled with water. The manure is then placed into windrows 7 or 8 feet high. These windrows are turned over twice a week with a scoop on a tractor for a period of 5 or 6 weeks. Even the feathers seem to be completely disintegrated.

Mr. John Prohoroff estimated that it would cost him \$60,000 to \$70,000 a year to follow the weekly cleaning program followed by many poultrymen. As a result of composting, he has an easy-to-handle, saleable organic fertilizer that returns enough to cover his costs, overhead, and maintenance of his equipment for handling the manure.

Removal of the manure is a twice-a-year job.

No address given.

Salinity and Alkali Problems

Rauser, W. E., and Crowle, W. L. SALT TOLERANCE OF RUSSIAN WILD RYEGRASS IN RELATION TO TALL WHEATGRASS AND SLENDER WHEATGRASS. *Canad. J. Plant Sci.* 43: 355-360. 1963.

Salt tolerance of Russian wild ryegrass was compared with that of tall wheatgrass and slender wheatgrass in controlled germination experiments and in a field trial. There appeared to be specific salt toxicity when Russian wild ryegrass was germinated in saline saturation soil extracts and sodium sulphate solutions. The absolute germination of this species was intermediate between that of tall wheatgrass and slender wheatgrass in the osmotic range up to 12.15 atmospheres. In the field, it was found that Russian wild ryegrass would establish, persist, and produce well in soil concentrations giving osmotic pressures up to 4.5 atmospheres (12 mmhos/cm. conductivity). Although the salt tolerance of Russian wild ryegrass was not so great as that of tall wheatgrass, it was quite comparable to that of Primar slender wheatgrass and above previously recognized levels.

Ontario Agr. Col., Guelph, Ontario, Canada.

Laktionov, B. I. NATURE OF THE HIGH DISPERSITY OF SOLONETZIC SOILS AND METHODS FOR THEIR CHEMICAL MELIORATION. *Soviet Soil Sci.* 6: 635-642. June 1962.

The nature of high dispersity of solonchaks was studied and the methods for their chemical melioration were given. The author concluded that:

1. The relationship between the amount of adsorbed sodium and the degree of dispersion in the soil mass of a solonchak was not invariably confirmed theoretically and experimentally. Adsorbed sodium did not in all cases serve as the basic criterion of the degree of dispersion.

2. The aggregation capacity of highly dispersed particles in the soil depended on the nature of these particles and on the properties of the soil solution. The stabilizing factor was the hydrated film on the surface of the soil particles.
3. The flocculating force of ions depended mainly on their dehydrating capacity; polyvalent ions were the most potent in dehydrating soil particles.
4. The high-dispersion property of a solonetz soil mass was eliminated by the flocculation of the highly dispersed particles; the amount of meliorating material was calculated from the dispersion index and adjusted by field tests.
5. Ferric sulfate was a good aggregator and meliorator of chestnut-belt solonetztes.

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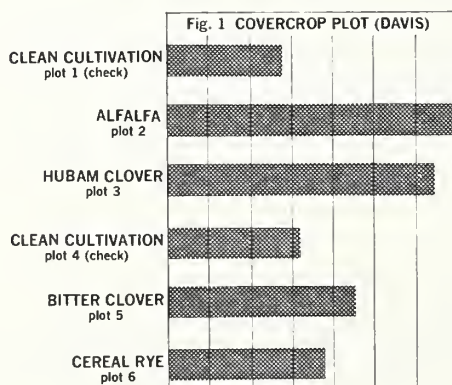
Cover Crops and Green Manure Crops

Werenfels, L., Proebsting, E. L., Warner, R. M., and Tate, R. COVER CROPS IMPROVE INFILTRATION RATES. Calif. Agr. 17(5): 4-5. 1963.

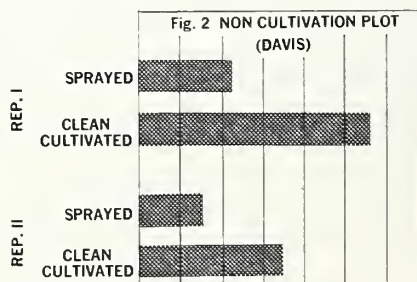
The problem of slow water penetration into California soils is particularly important in orchards, where compaction layers interfere with downward water movement and cannot be broken up by deep plowing. Cover crops, sawdust mulch, and nontillage soil management practices in orchards were investigated. The ring infiltrometer method was used to measure water penetration.

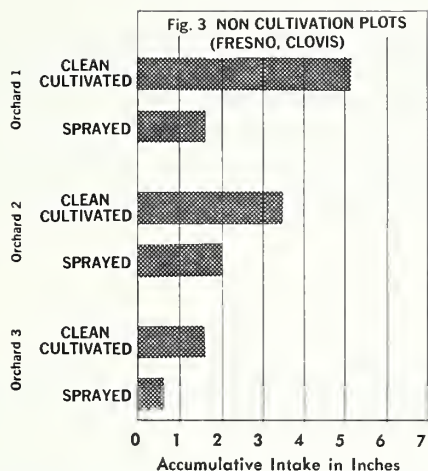
The results are shown by the following graphs:

Graph 1—Accumulative water intake in 90 minutes. Each bar on graph represents the arithmetic mean of eight infiltrometers in a Davis apricot orchard.

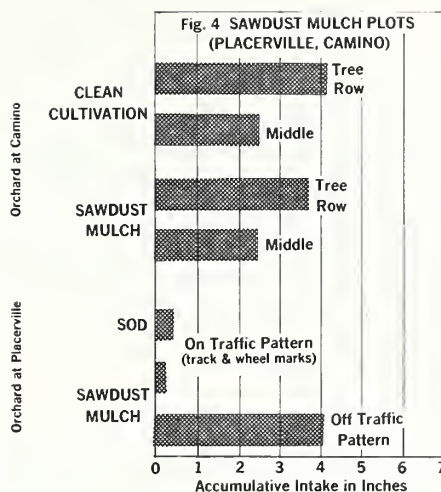


Graph 2—Accumulative water intake in 45 minutes. Each bar on graph represents the arithmetic mean of six infiltrometers in a Davis walnut orchard.





Graph 3—Accumulative water intake in 20 minutes (orchard 1) and 60 minutes (orchard 2 and 3). Each bar on graph represents the arithmetic mean of four infiltrometers in Fresno fig orchards.



Graph 4—Accumulative water intake in 15 minutes (Comino pear orchard) and 60 minutes (Placerville pear orchard). Bars on graph represent the arithmetic mean of four infiltrometers for the Camino orchard and for the Placerville orchard, the mean of five infiltrometers (sod on traffic), the mean of six infiltrometers (sawdust on traffic pattern) and the mean of three infiltrometers (sawdust off traffic pattern). Tree rows show better intake than middles because of less traffic.

U. Calif., Davis, Calif.

Climatic Influences

Bark, L. D. WEEKLY PRECIPITATION AMOUNTS FOR KANSAS. Kans. Agr. Expt. Sta. Tech. B. 126, 101 pp. 1963.

The weekly precipitation totals for 24 stations in Kansas were presented for at least 50 years of weekly data. In addition, the weekly normals (30-year average, 1931-60) were computed and included so that surpluses and deficits for particular weekly periods could be determined. Weekly totals and normals were computed from the Weather-punch-card Library of the Kansas Agricultural Experiment Station.

The data were processed according to the climatological week number. Week numbers start with March 1, to avoid the confusion of the extra day in leap year. Using this system, each day of the year occurs within the same week.

Tables.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Bark, L. D. CHANCES FOR PRECIPITATION IN KANSAS. Kans. Agr. Expt. Sta. B. 461, 83 pp. 1963.

By studying statistically the many years of precipitation records in Kansas, one can estimate the chances of receiving certain amounts of rainfall in a given period. This knowledge lets one establish risk of operation or develop calendars of operation that entail the least risk.

Statistical odds for receiving certain amounts of precipitation at various times during the year for 24 locations in Kansas were given. Comparisons can be made among different times of the year at the same station.

Maps, tables, and charts.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Stoffer, R. V., and Van Riper, G. E. EFFECT OF SOIL TEMPERATURE AND SOIL MOISTURE ON THE PHYSIOLOGY OF SORGHUM. Agron. J. 55: 447-450. 1963.

RS610, RS608, and Martin varieties of sorghum were studied at four temperature dates of planting in the field and over three temperatures and four soil moisture levels under controlled conditions in growth chambers. The sorghums were evaluated for emergence, dry matter accumulation, and nitrogen, phosphorus, and iron uptake.

Highest percentage emergence was obtained in the field at the third and fourth temperature-dates where the sunrise soil temperatures at a 4-inch depth were 65° F. and 70° F., respectively, at planting time. A specific date for planting cannot be established because of the high degree of variability in the relationship of temperature to time of year in Nebraska. The sunrise temperature at 65° F. at a 4-inch soil depth did provide an estimate of the minimum temperature necessary for emergence in the field and in the controlled study.

Dry weight and mineral uptake of field grown plants at the eight-leaf stage apparently was affected by soil moisture as well as by temperature. Under controlled conditions, dry weight and mineral uptake generally increased with increased temperature from 60° to 80° F. and with increased soil moisture from 25 to 100 percent availability.

Grain yield was generally increased with each higher planting temperature from 49° to 70° F. in the field and was dependent on the number of heads per unit area rather than the weight of seed per head. Carbohydrate content of the seed generally increased with each higher planting temperature.

Significant positive correlations were found between dry weight and mineral content in milligrams per plant and among the different minerals (N, P, and Fe) expressed in milligrams per plant in both studies.

The lack of correlation noted between dry weight and mineral content expressed in percentage and between milligrams of minerals and percentages of minerals indicates that the ratio of the minerals to the plant weight remains relatively constant even when total mineral uptake increases.

Cornell U., Ithaca, N.Y.

Ashcroft, G. L., and Derksen, W. J. FREEZING TEMPERATURE PROBABILITIES IN UTAH. Utah Agr. Expt. Sta. B. 439, 35 pp. 1963.

Tables that give the change of occurrence of certain critical temperatures were given for Utah. Information was given, which can be used in connection with these tables, to determine the chance of plant damage from a freeze. When the relative chance of freeze damage occurring on different days of the year is known, decisions can be made on species or varieties of plants to grow. The best time for planting and harvesting can also be determined.

Utah State U., Logan, Utah.

Baker, D. G., and Strub, J. H., Jr. CLIMATE OF MINNESOTA; PART I. PROBABILITY OF OCCURRENCE IN THE SPRING AND FALL OF SELECTED LOW TEMPERATURES. Minn. Agr. Expt. Sta. Tech. B. 243, 40 pp. 1963.

Of concern to agriculture, to other industries, and pursuits of man dependent upon weather, is the spring date after which the season will be free of certain low temperatures, particularly freezing temperatures. Similarly there is need for information when these same temperatures may first be expected to occur near the end of the season. Such information based upon a climatological prediction was given in table form for Minnesota.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

Sanderson, C. J. THE PROBABILITY OF FREEZING TEMPERATURES IN SPRING AND FALL IN NORTH DAKOTA. B. 443, 24 pp. 1963.

The last occurrence of freezing weather in the spring and the first in the fall, and the length of the period through the summer months during which no freezing weather occurs, are important to the agricultural economy of North Dakota. The records help in establishing limits and in determining crops which can be grown successfully.

While most farmers know about when it is safe to seed various crops to be reasonably sure they will not be damaged by a later freeze, it is doubtful that these same farmers can put an accurate estimate on the probability of a freeze occurrence on or by a certain date. As a result, some may have allowed a larger "safety factor" than necessary while others are taking a greater "risk" than they realize.

Tables showing the probability of freeze occurrence in Spring and Fall in South Dakota were given based upon observed temperature records over a period of years.

Tables and maps.

Agr. Expt. Sta., N. Dak. State U. Agr. and Appl. Sci., Fargo, N. Dak.

Pustovoytov, N. D. INFLUENCE OF SEASONAL FREEZING ON THE WATER REGIME OF AMUR SOILS. Soviet Soil Sci. 6: 575-583. June 1962.

The influence of seasonal freezing on the water regime of Amur soils was studied. The authors concluded that:

1. The course of freezing and thawing of the soil-forming complex was affected not only by the mean daily temperatures but also by the minimum and maximum air temperatures.

2. Two phases in the seasonal freezing process must be distinguished: (1) The phase of effective freezing; and (2) the phase of isothermic heat exchange. The first phase corresponds to the period of maximum freezing of the soil and determines the thickness of the seasonal frozen layer, while the second phase corresponds to isothermal heat exchange, when the coming of warm weather is balanced by heat loss.
3. Thawing of the seasonal frozen layer takes place, as a rule, from the top downwards. Freezing from below upwards is insignificant owing to the infinitesimal heat increment and is of no practical importance.
4. Thawing of the seasonal frozen layer is completed 1.3 to 1.5 times more rapidly than its freezing. The temperature of the thawed layer is more important for agricultural purposes than its thickness. Low soil temperature retards growth and the development of plant roots.
5. The difference in depth of soil freezing in forest and in plowland may be as much as 30 to 50 cm.; and the difference in duration of the seasonal freeze was 13 to 15 days.
6. Seasonal freezing and thawing in drained land began 17 to 21 days earlier than in water-logged, with the result that the vegetation period began earlier in drained than in water-logged land.
7. Moisture migrates from the lower, unfrozen layers into the frozen zone and the unfrozen layers became dehydrated as the soil gradually freezes.

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Weitzman, S., and Bay, R. R. FOREST SOIL FREEZING AND THE INFLUENCE OF MANAGEMENT PRACTICES, NORTHERN MINNESOTA. U.S. Forest Serv. Res. Paper LS-2, 8 pp. 1963.

Snow depth, soil texture, and cover type and density were related to depth and duration of soil freezing. Many other factors must be studied before the full and composite effect of forest cover and its manipulation are understood. The results indicate the conditions that reduce ground freezing to provide an opportunity for water to enter the soil rather than run off in spring freshets. The authors concluded that:

1. Frost depth and duration varied from year to year, depending on natural climatic factors such as moisture in soil and snow depths.
2. Sandy-textured soils had less concrete frost than fine-textured soils that retained more water.
3. The pattern of freezing in an organic soil was similar to that of mineral soils, but frost lasted much longer in organic material.
4. Thinning in a conifer and a hardwood stand slightly reduced the depth and duration of frost, largely because of a greater accumulation of snow.
5. Freezing under hardwoods was less severe than under conifers.
6. A mixed stand of scattered conifers and hardwoods (white pine-hardwoods) combined the advantages of the lowest incidence of frost and the greatest accumulation of snow.
7. Open areas had greater depth and duration of concrete frost than forested areas.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Mulching

Miller, D. E., and Bunger, W. C. USE OF PLASTIC SOIL COVERS IN SWEET CORN PRODUCTION. Agron. J. 55: 417-419. 1963.

Strips of clear-perforated and clear-nonperforated plastic film and perforated black plastic film were used to cover rows of sweet corn planted at three different dates. Clear plastic caused increased soil temperatures, thus encouraging early emergence and development of the sweet corn. Plants growing through clear-perforated strips were ready to harvest 1 week earlier than those on bare soil. Combinations of early seeding and seeding through clear plastic strips resulted in sweet corn ready for harvest about 2 weeks earlier than corn seeded at a normal time in bare soil.

SWCRD, ARS, USDA, Prosser, Wash. 99350

Hatchett, W. P., and Bloodworth, M. E. EFFECT OF PETROLEUM AGRICULTURE MULCH AS A COVERING FOR DRYLAND SEED DRILLS. Tex. Agr. Expt. Sta. Prog. Rpt. 2265, 7 pp. 1963.

Petroleum agricultural mulch showed an increased cotton seedling emergence in a test at Spur, Tex., during 1962. Increased seedling emergence over the check was 118, 123, and 230 percent, respectively, for 60, 125, and 170 gallons per acre of petroleum mulch material.

Soil temperature at seed level was not affected by the mulch at any rate.

Soil moisture percentages 4 days after planting were higher for all rates of the petroleum mulch material than for the check. Below the seed zone, soil moisture differences between all treatments were very slight.

No yield differences were noted among the treatments.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

PLANT MANAGEMENT

Pasture and Haylands

Hunter, E. C. FORAGE PROGRAMS AND CATTLE SYSTEMS: COLORADO MOUNTAIN-MEADOW CATTLE RANCHES. U.S. Dept. Agr., Econ. Res. Serv. ERS-100, 18 pp. 1963.

Cattle raising is the major agricultural activity in the mountainous portions of Colorado. Meadows produce practically all of the winter feed and some of the summer grazing for these cattle. The production from these meadows is low; average hay yields for Colorado meadows seldom exceed 1 ton per acre. The yield per acre has declined somewhat over the past 50 years. Recent trials showed that with improved practices, a large portion of these meadows could produce considerably more forage.

Five improved meadow-management programs were examined to produce additional forage for a lower cost. Each of the improved practices reduced the cost per ton of producing hay. The analysis revealed that the lowest production cost per ton of hay was realized when the meadow was rough-leveled (extreme low and high spots removed) and reseeded, followed by a program of phosphate fertilization and the periodical reseeding of legumes (for a typical ranch \$13.55 per ton).

The next lowest cost combination per ton was a rough-leveling, reseeding, and nitrogen-fertilization program (\$14.29), followed by nitrogen-fertilization (\$15.52), rough-leveling and reseeding (\$15.64), and phosphate fertilization and periodic seeding of legumes (\$15.93). Comparable costs under usual management practices were \$16.27 per ton.

In each instance, adequate water control was the key to the success of the improved forage programs. This was undoubtedly the reason that the rough-leveling programs were able to produce hay for the least cost, because rough-leveling increased the opportunity to improve control over irrigation.

The relative profitableness of various livestock systems for a typical Colorado mountain-meadow ranch were analyzed when the meadow was managed under a rough-leveling, reseeding, and nitrogen-fertilization program.

This meadow-management program was used rather than the least-cost program (rough-leveling, phosphate fertilization, and periodic seeding of legumes) because of the higher yield per acre. The larger production of hay allowed the cattle operation to be somewhat larger. Also, the least-cost combination was more limited in adaptability.

Five livestock systems were budgeted for a typical mountain-meadow ranch. Two of them examined the typical ranch with a grazing permit for 150 cattle on Federal rangeland. Returns to the operator for his labor and management for a cow-calf system amounted to \$1,735 annually, compared with \$2,740 for a cow-yearling system. When the cow-yearling system was budgeted on the same ranch without a grazing permit, the return to the operator was \$1,455 annually. Without a grazing permit, the most profitable system was fall-purchased calves--wintered and grazed through the summer. This system produced a return of \$3,545 annually to the operator. If calves were bought in the spring and sold in the fall--an exclusive summer-grazing system without a grazing permit--the returns were \$2,275 annually.

With a Federal grazing permit, the operator has an opportunity to increase the scale of this operation and income. Improved forage practices and use of the most profitable livestock system for a particular ranch may be a way to increase the scale of operation and income. Improved forage management and selection of the best livestock program can influence net ranch returns as much as or more than the gain or loss of a Federal grazing permit without any change in production practices or livestock management.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Whitman, W. C., Langford, L., Douglas, R. J., and Conlon, T. J. CRESTED WHEATGRASS AND CRESTED WHEATGRASS-ALFALFA PASTURES FOR EARLY-SEASON GRAZING. N. Dak. Agr. Expt. Sta. B. 442, 24 pp. 1963.

A 7-year, early-season grazing trial with yearling steers on crested wheatgrass-alfalfa pastures was conducted at the Dickinson Experiment Station, North Dakota, during 1955-61.

The steers grazed the pastures for an average seasonal period of 56 days. The average dates of the pasture season were May 7 to July 1. Throughout the 7-year period, the crested wheatgrass-alfalfa pastures were superior to the crested wheatgrass pastures in forage and beef production.

The crested wheatgrass-alfalfa pastures showed a 1/3 greater grazing capacity than the crested wheatgrass pastures, supporting 1 yearling steer per acre, while 1.33 acres were required to support a steer on the crested wheatgrass pastures for the grazing period. The crested-alfalfa pastures produced an average of 27.3 percent more forage than crested wheatgrass pastures, and the grazing animals consumed 27.5 percent more forage from them.

The yearling steers gained a little over 2 pounds per head per day on both sets of pastures, and the average gain per head for the pasture season was 116 to 117 pounds, with no

essential difference in either rate of gain or total gain per head on either set of pastures. Gains per acre averaged 88.4 pounds on the crested wheatgrass pastures and 117.3 pounds on the crested wheatgrass-alfalfa pastures.

Average daily forage consumption of the animals while on pasture was 17.5 pounds dry-weight per head per day on the crested wheatgrass pastures and 17.0 pounds per head per day on the crested wheatgrass-alfalfa pastures. The average amount of forage required per pound of gain was 8.4 pounds on the crested pastures and 8.1 pounds on the crested-alfalfa pastures.

The alfalfa was an important component in the crested wheatgrass-alfalfa pastures only in the first 2 years. However, its presence continued to influence pasture yield and forage quality as indicated by protein content throughout the period of the trial. Heavy early season grazing apparently was unfavorable to the maintenance of alfalfa in the stand. Except for the loss of alfalfa from the mixtures, none of the pastures showed any appreciable stand deterioration during the period of the grazing trial.

Tables.

Agr. Expt. Sta., N. Dak. State U. Agr. and Appl. Sci., Fargo, N. Dak.

Fergus, E. N. RED CLOVER IN KENTUCKY. U. Ky. Coop. Ext. Serv. C. 589, 13 pp. 1963.

Detailed information on the care and production of red clover including soil preparation, varieties, harvesting seed, controlling diseases and insects, and curing hay was given.

U. Ky., Coop. Ext. Serv. Agr. and Home Econ., Lexington, Ky.

Launchbaugh, J. L., and Anderson, K. L. GRASS RESEEDING INVESTIGATIONS AT HAYS AND MANHATTAN, KANSAS. Kans. Agr. Expt. Sta. T. B. 128, 22 pp. 1963.

Dates of seeding grasses at Manhattan and Hays, Kans., gave similar results when planting dates at both locations were comparable. Considering initial stands, second-year survivors, incidence of poor stands, and complete failures associated with dates of seeding, the period of March 15 through May 15 appeared to be the best time to plant warm-season native grasses. In the case of cool-season grasses, acceptable stands of western wheatgrass were obtained most consistently from plantings made between January 1 and May 15, while smooth brome could be sown at Manhattan with equal stand success any time from October 1 through April 1. October through December plantings of most species occasionally failed to produce seedlings while June through September plantings either were complete failures or produced stands ranging from a few to large numbers of seedlings, many of which were lost during the first winter. These extremes in success did not occur when plantings were made between January 1 and May 15.

Types of residue, comparing grain sorghum, forage sorghum, and sudangrass for a prepared stubble-mulch seedbed, had no effect on initial grass seedling numbers at Hays, but seedling growth and consequent second-year stands were delayed in development in sudangrass stubble because of competing covercrop volunteer the first year. Late planting of the cover crop to avoid seed production or the use of soft-seeded sorghum types with low volunteer potential would minimize the chances of producing first-year competing vegetation.

Both warm- and cool-season grasses were planted at Hays in late fall, mid-winter, and spring during a 3-year period in covers of unharvested forage sorghum and in medium-height

and short sorghum stubble. No consistent advantage in obtaining seedling stands could be detected for any particular amount of residue. Big bluestem was favored by high and medium amounts of seedbed cover on all planting dates. Sideoats grama produced stands of the same density when planted early regardless of cover amount, but when sown in April high amounts of cover resulted in the greatest number of seedlings. Early and late switchgrass plantings produced stands of equal density in all amounts of cover. Western wheatgrass came up in thicker stands from late fall and mid-winter plantings 2 years out of 3 where there were low amounts of cover. Early plantings during 1 year and April plantings during 3 years were best under high amounts of residue and poorest under low amounts. Heavy seedbed cover was more effective than light cover in keeping soil temperatures lower during the warmest period of the day and in retaining moisture in the seed zone for significantly longer periods. However, intervals between rains were not of sufficient duration within the period to create spring drought conditions which would truly test the effectiveness of various amounts of seedbed cover in preventing stand failures. Fewer weeds were produced under high amounts of residue than under medium and low amounts.

Planting grasses at the proper time had a more profound effect on initial and surviving seedling numbers than type or amount of seedbed cover. It appeared that high amounts of preparatory crop residue were more essential for April grass plantings than for seedlings made during late fall and mid-winter.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Elder, W. C. EFFECT OF FOUR LEGUMES AND NITROGEN FERTILIZER ON GREEN-FIELD BERMUDAGRASS. Okla. Agr. Expt. Sta. Processed Ser. P-452, 5 pp. 1963.

The seasonal growth and effect of four legumes growing with Greenfield bermudagrass at Stillwater, Okla., were determined. Nitrogen fertilizer was applied on bermudagrass plots in order to compare results to those of legumes. A mixture of Ladino clover and bermudagrass was superior to winter annual clovers overseeded on the grass. Total production was similar for big hop, crimson clover, and vetch when all vegetation was clipped at monthly intervals from April to September. Vetch and crimson clover residue returned to the soil stimulated bermudagrass growth in summer months, but hop clover had little effect on the grass. Total production of vetch and crimson clover was equal to 100 pounds of nitrogen per acre applied on the grass, and seasonal production was in favor of the legumes.

Okla. State U. Expt. Sta., Stillwater, Okla.

Branaman, G. A., and Harrison, C. M. STEER FEEDING UNDER VARIABLE PASTURE AND GRAIN SUPPLEMENT PRACTICES. Mich. Agr. Expt. Sta. Spec. B. 443, 40 pp. 1963.

In order to gain more insight into the usefulness of different ways of using forage and grain during the summer period, experiments were conducted with feeder steers over the period 1944-58 on the Experiment Station Farm of Michigan State University at East Lansing. The authors concluded that:

1. It was possible to get steers to marketable finish using any one of the many feeding techniques employed without great differences in total cost over the entire feeding period. The type of feeding program selected by a farmer should depend largely on the farm production practices and market conditions prevailing.

2. Thin cattle going to pasture tended to gain faster and more economically than fleshier cattle and thin cattle off pasture tended to gain faster and more economically in the feedlot.
3. Neither alfalfa-brome nor grass hay alone maintained much grass fat on yearling steers during the winter period but thin, long yearling steers tended to gain very rapidly on good pasture.
4. Cattle pastured on high quality pasture without grain supplement not only tended to grow more and take longer to finish in dry lot but attained similar finish at heavier weights than cattle fed supplemental grain on pasture.
5. Large quantities of hay and pasture may be used in a feeding program by taking weanling calves through two winters and two summers. However, heavy grass cattle sell at a less attractive price than lighter cattle and heavy, corn-fed cattle often sell at a lower price than cattle finished at a lighter weight.
6. In furnishing fresh chopped forage to cattle, fresh material should be delivered at least daily and care should be exercised to keep the chopped material of high quality.
7. When feeding fresh chopped forage to cattle, adequate grain supplement should be added to maintain a balanced ration and satisfactory gains. The combination of fresh chopped forage and corn resulted in bringing cattle to market weight and finish at a much earlier date than where only fresh chopped forage was fed for a period.
8. Either fresh chopping or some system of strip grazing, though more expensive to operate, saved on first crop forage acreage in comparison to continuous grazing.
9. Limited grain feeding of steers on pasture allowed the use of more forage and less corn. The daily gains were slightly lower than where corn was full-fed. Such steers finished at heavier weights and were marketed at a later date in comparison to the full-feeding of corn to similar steers on pasture or in dry lot.
10. Increasing the amount of corn on pasture as the season progressed was preferable as a system of fattening cattle when compared to a more constant limited quantity throughout the pasture season.
11. Satisfactory corn feeding on pasture depended on conditions which insured adequate corn intake, such as location of feed bunk, water, shade, and salt.
12. Cattle gains tended to be similar when fed corn liberally on pasture, with chopped forage, or in dry lot. Fresh forage use tended to save some corn.
13. Cattle on straight grass pasture gained fully as well as on alfalfa brome for the first 6 to 8 weeks of the pasture season, but tended to gain less in middle to late summer.
14. Cattle fed on dry feed tended to have slightly whiter fat in the carcass than those fed chopped fresh forage or pasture.
15. The weight of cattle, gain per head, cost of gain, and cattle price must be considered together to determine profit in any procedure with growing or fattening cattle.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Brown, M. A., and Rupel, I. W. COMPARATIVE EFFECTS OF HAYLAGE AND OTHER FORAGES ON MILK PRODUCTION AND FEED COSTS. Tex. Agr. Expt. Sta. Prog. Rpt. 2263, 4 pp. 1963.

A feeding trial was conducted from April 1, 1961, to March 31, 1962, in the A&M College of Texas dairy herd to compare the effects of haylage partly dried forage (ensilage stored in gas-tight silo) and other forages on milk production and feed costs. A group of 10 Holsteins and 16 Jerseys produced an average of 25.7 pounds of milk containing 4.24 percent butterfat and consumed an average of 27 pounds of haylage, 6.8 pounds of alfalfa hay,

and 10.3 pounds of concentrates per cow per day. A similar control group of cows produced an average of 31.2 pounds of milk containing 4.12 percent butterfat and consumed an average of 5.4 pounds of alfalfa hay, 8.9 pounds of Atlas sorgo silage, 24.9 pounds of Atlas sorgo green chop, 43.9 pounds of pasture, and 12.2 pounds of concentrates per cow per day. The average cow in the control group consumed slightly more dry matter in her ration each day than the cow on the part haylage ration.

The average cows in the control and haylage groups were fed at a total daily feed cost of 68.8 cents and 55.3 cents, respectively. Although cows receiving haylage produced 100 pounds of 4 percent FCM (fat-corrected milk) at a feed cost of \$1.61 as compared with \$1.83 for the controls, cows in the latter group returned an average of \$1.03 per cow per day over feed costs. The average cow on the part haylage ration returned approximately 80 cents per day income over feed costs. The failure of haylage-fed cows to maintain daily milk production levels equal to cows in the control group accounted for the advantage to the controls in dairy returns over feed costs.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Mishra, M. N., Pendleton, J. W., Mulvaney, D. L., and Johnson, P. E. INVESTIGATIONS OF HIGH-POPULATION CORN FOR FORAGE AND GREEN MANURE. Agron. J. 55: 478-480. 1963.

High-population corn (200,000 plants per acre) was evaluated at 3 locations in Illinois over a 3-year period for forage or green manure.

Two crops a year of high-population corn yielded more pounds of dry forage and protein than one crop of high-population corn which in turn yielded more than conventional corn in 40-inch rows harvested as silage. However, the high moisture content and lack of grain on the high-population plants indicated relatively poor silage characteristics as compared so that from conventional stands of corn.

Two crops per year of high-population corn plowed under as green manure gave higher yields of corn grain the succeeding 2 years than conventional corn or high-population corn removed for silage. However, the plowing under of such great amounts of material (80,600 pounds green or 14,650 pounds of dry weight per acre) failed to produce higher corn yields in succeeding years than the conventional Corn Belt practice of growing spring oats inter-seeded with a mixture of the two legumes, red clover and alfalfa.

The authors state that the growing of extremely high populations of corn (200,000 plants per acre) seemed to have very limited practical value either as silage or green manure. Because of rapid growth and high yields, such corn crops may find limited use in green chop programs.

Ill. Agr. Expt. Sta., Urbana, Ill.

Klosterman, E. W., Johnson, R. R., Moxon, A. L., and Scott, H. W. FEEDING VALUE OF LIMESTONE TREATED CORN SILAGES FOR FATTENING CATTLE. Ohio Agr. Expt. Sta. B. 934, 27 pp. 1963.

Samples of high moisture shelled and ground ear corn stored in conventional silos were found to contain acetic and lactic acids. These are the same as the predominant acids found in whole plant silage and are similar to those produced in the rumen of cattle fed fattening rations.

Laboratory experiments with whole plant and ground ear corn ensiled in glass jars showed that the acetic and lactic acid contents of the resultant silages were directly related to the moisture content of the material ensiled. Additions of 1 percent of a neutralizing material such as calcium carbonate, high calcium limestone, or a mixture of limestone and urea markedly increased acid production in the silo.

Four feeding experiments with ensiled ground ear corn and four with whole plant silage, involving a total of 598 cattle, were conducted to compare the feeding value of treated and untreated silages. All eight experiments showed an increase in feed efficiency as a result of adding 1 percent limestone, 1 percent of a mixture of limestone and urea, or, in the case of ground ear corn, these additives in combination with additional water to the corn at the time of ensiling. In four of the experiments, cattle fed the treated silages gained at a significantly faster rate.

Digestion experiments with wether lambs showed that the addition of limestone did not decrease the digestibility of organic matter, cellulose, crude fiber, protein, or ether extract of the whole plant or ground ear corn silages.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Hall, O. G., and Felts, J. H. COMPARATIVE FEEDING VALUE OF DIFFERENT SILAGES FOR THE PRODUCTION OF SLAUGHTER BEEF HEIFERS. Tenn. Agr. Expt. Sta. B. 360, 30 pp. 1963.

Six experiments involving 264 beef heifer calves were conducted at the Tobacco Experiment Station in Tennessee to determine the comparative feeding value of different silages when supplemented with a limited amount of concentrates for the production of slaughter beef heifers. The heifers were fed a high silage-low concentrate ration for about 120 to 140 days during the fall and winter, followed by a full-feed of concentrates for 56 to 90 days. The heifers were usually sold for slaughter in early May, when they graded Good in condition and had attained a weight of 750 to 800 pounds.

In the first series of three experiments, corn, sorghum, orchardgrass-ladino clover (preserved with molasses), and small grain silages were compared. In the second series of three experiments, alfalfa, orchardgrass-ladino clover (chemically preserved), orchardgrass-ladino clover (preserved with molasses), and small grain silages were fed to the heifers. The major results were:

1. In the first series of experiments--(1) Daily gains of calves fed corn silage and orchardgrass-clover silage rations averaged about 1.70 pounds per head for the three experiments. Slightly over 700 pounds of air-dry feed were required per hundredweight gain and feed costs were only 11.3 to 11.6 cents per pound of gain. The performance of the calves fed the orchardgrass-clover silage ration was consistently equal to that of calves fed the corn silage ration. (2) Calves fed the sorghum silage ration gained 0.1 pound per head daily less than those fed corn and grass silage rations. And (3) performance of the calves fed the small grain silage ration was significantly inferior to that of the other groups of calves. These calves averaged only 1.23 pounds gain per head daily, and they required 868 pounds of air-dry feed per hundredweight gain.
2. In the second series of experiments--(1) Calves fed the alfalfa silage ration gained significantly faster and required less air-dry feed per hundredweight gain than did calves fed orchardgrass-clover silage and small grain silage rations. (2) Calves fed orchardgrass-clover rations gained only slightly more than 1 pound per head daily, as compared to an average daily gain of 1.70 pounds for calves fed this kind of silage

ration in the first series of experiments. Visual observations and chemical analyses of the silages used in both series of experiments did not indicate marked differences in the quality of the silages. (3) Performance of calves fed orchardgrass-clover silage preserved with 30 to 35 pounds of dried molasses per ton was not significantly different from that of calves fed orchardgrass-clover silage preserved with a chemical preservative (sodium metabisulfite). However, some difficulty was encountered with apparent cases of botulism in 2 of the 3 years in which the chemically preserved grass silage was fed. And (4) differences in the digestibility (as determined with beef steer calves) of the dry matter, crude protein, and nitrogen-free extract of the alfalfa, orchardgrass-clover, and small grain silage rations fed during the last two experiments were not statistically significant. The crude fiber in the alfalfa silage was significantly less digestible than the crude fiber in the other silages.

3. During the full-feeding phase, the heifers averaged 2.24 pounds gain per head daily and 839 pounds of feed were required per hundredweight gain. About 68 days were required to raise the condition grade of the heifers from Standard to Good.
4. Based on all groups of heifers fed different silages, the returns per head over feed costs ranged from a low of \$21.63 in 1960-61 to a high of \$49.85 in 1958-59.
5. The best animal performance was obtained with corn silage followed closely by sorghum, alfalfa, and orchardgrass-clover.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Jones, T. N. IMPROVED FORAGE BOX. Miss. Agr. Expt. Sta. B. 664, 7 pp. 1963.

Better methods and equipment are necessary for continued economical improvement of the livestock program in Mississippi.

Equipment for moving forage from the field to green feeding or storage is available from many sources today. The user must determine if the equipment will be used for silage handling only, or if needed for other types of forage production.

The forage box presented includes refinements and improvements made by the Agricultural Engineering Department of the Mississippi Agricultural Experiment Station. It can be built at home if facilities are available or in a shop equipped for this type of construction. This plan is designed to produce a forage box capable of lasting a minimum of 10 years.

The box may be used on several types of vehicles, such as the four-wheel trailer or trucks. If the four-wheel trailer is used, it should be of a heavy type as the box has a capacity of 5 to 6 tons of green forage. Normally the forage is unloaded by a gear reduction box driven with one-third H.P. electric motor. If mounted on a truck, the forage may be unloaded with power from the truck power take-off.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Rangelands

Judd, B. I. PRINCIPAL FORAGE PLANTS OF SOUTHWESTERN RANGES. Rocky Mountain Forest and Range Expt. Sta., Sta. Paper 69, 93 pp. 1962.

The principal forage plants of southwestern range were described and illustrated. The plants described included grasses and grass like plants, forbs, trees, and shrubs.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Hull, A. C., Jr., Holmgren, R. C., Berry, W. H., and Wagner, J. A. PELLET SEEDING ON WESTERN RANGELANDS. U.S. Dept. Agr. Misc. P. 922, 34 pp. 1962.

The available documented information on pellet seeding of western rangelands including: (1) Sixteen large-scale range seedings totaling more than 180,000 acres; (2) widespread experimental field tests; and (3) numerous laboratory and greenhouse studies were given. Compressed earthen pellets and coated seed pellets were used in the seedings, which covered a wide range of conditions during the 16-year period 1946-61. Extruded seed pellets were used in one test in 1951.

Large-scale airplane seedings with compressed earthen pellets and with coated pellets were made during five seasons. Of the 16 seedings reported, 10 were declared failures and the remaining 6 unsatisfactory.

Most of the large-scale field plantings were paralleled by experimental studies in which airplane broadcasting of pelleted seed was subjected to direct comparison with other methods of range revegetation. Pelleted seed had no advantage over nonpelleted seed so far as grass establishment was concerned. Drilling was superior to broadcasting, and successful establishment of grass on these arid rangelands required elimination of the competing vegetation.

Greenhouse and laboratory studies revealed that a varying but sometimes very high percentage of the seeds of grasses put into compressed earthen pellets were injured by the pelleting process. Coated seed pellets retained high germinability.

Airplane broadcasting of compressed earthen pellets on an unprepared seedbed cost \$2.55 per acre at a rate of 1.2 pounds of seed per acre. No satisfactory stands were obtained, even when an increased rate of seeding was used.

On seedbeds prepared by burning, airplane broadcasting of 6 pounds of seed in coated seed pellets yielded in the second year $1\frac{1}{2}$ pounds of grass per dollar invested. Broadcasting of natural seed yielded 6 pounds, and drilling yielded 42 pounds.

When the seedbed was prepared by plowing, airplane broadcasting of coated seed pellets yielded 13 pounds of grass per dollar invested. Broadcasting of natural seed yielded 21 pounds, and drilling yielded 71 pounds.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

Passey, H. B., and Hugie, V. K. FLUCTUATING HERBAGE PRODUCTION ON AN UNGRAZED SIEROZEM SOIL IN IDAHO. J. Soil and Water Conserv. 18: 8-11. 1963.

Both herbage yields and species composition of a specific stand of native range vegetation varies over a period of years. Neither a single observation nor the data collected during a single season can be expected to define accurately the limits of such variations. From a single observation, it is difficult to determine whether the current year's total herbage production or that of individual species represents low, average, or high production for a particular range site. Such information is essential for accurate recognition of the true characteristics of potential native plant communities.

The approximate yield and variations in production that may be expected in favorable and less favorable years is probably more important to the landowner than the average production that can be expected. To assure proper range use, such annual and periodic fluctuations in production require timely adjustments in stocking rates. Stocking based on an average expected production level does not permit the flexibility of management required to compensate for fluctuations in herbage production.

Individual plant species did not follow the same pattern of variation in production from year to year. Bluebunch wheatgrass and Sandberg bluegrass production varied in somewhat

the same manner as did total herbage production. Thurber needlegrass was the only species whose yields declined consistently during the 4-year study period. Herbage production of forbs increased from 1958 to 1959 while grass production declined. The pattern of production of annuals was the reverse of that of total herbage production. Big sagebrush yields declined in 1960 and 1961 at least partly because of insect damage.

Species composition also varied from year to year but not as erratically as did herbage production.

There was no consistent relationship between herbage production or species composition and precipitation. Fluctuations in species composition and herbage production may be more closely associated with available soil moisture during specific portions of the growing season than with the single climatic factor precipitation.

SCS, USDA, Denver, Colo.

Duvall, V. L., and Whitaker, L. B. SUPPLEMENTAL FEEDING INCREASES BEEF PRODUCTION ON BLUESTEM-LONGLEAF PINE RANGES. La. Agr. Expt. Sta. B. 564, 18 pp. 1963.

A test of supplemental feeding was conducted on forest range in central Louisiana from 1956-60. The experimental herds each contained 25 native cows. Between July and May, herd A received 561 pounds, per cow-year, of a mixed feed containing about 15 percent protein. Herd B was fed 373 pounds of cottonseed cake per cow annually between October and May. Cows in both herds received about 4 bales of hay during winter and had free access to loose salt and steamed bonemeal. Ranges were stocked yearlong at one cow per 20 acres.

During the 5 years, calf crops averaged 80 percent in herd A and 83 percent in herd B. Weanling weights at 6½ months were 443 pounds in herd A and 433 pounds in herd B. Slaughter grade averaged high Standard in both herds.

Calves from herd A sold for \$93.24 per head, those from herd B for \$90.10. Because feed costs were substantially higher for herd A, however, herd B calves returned \$5.23 more per head, exclusive of labor. Feeding required more labor for herd A than for herd B.

The study showed that cottonseed cake supplied in moderate amounts from October until May, salt and steamed bonemeal furnished free-choice yearlong, and a small amount of hay fed in late winter permit efficient, profitable beef production on forest ranges. This feeding program, together with good herd and range management, resulted in calf production far above the average for forest range cattle.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., University Station, La.

Plant Materials

Holt, E. C., and Bashaw, E. C. FACTORS AFFECTING SEED PRODUCTION OF DALLIS-GRASS. Tex. Agr. Expt. Sta. Misc. P. MP 662, 8 pp. 1963.

Dallisgrass is one of the more important forage grasses in the South, but seed yields generally are low and seed quality poor. Research showed that seed production and quality was improved significantly with certain management practices.

Late-winter or early-spring nitrogen applications increased the yield of the first seed crop. Utilization of forage, either as hay or for grazing prior to maturation of the first seed crop, delayed seed maturity and reduced seed yields. Planting in rows and cultivating helped maintain weed-free stands and helped in the application of irrigation water but did not influence yields or seed quality.

Dallisgrass seed set was sensitive to environmental factors. High temperatures (above 90° F.) and low minimum relative humidity (below 35 percent) were detrimental to seed set. In South Central Texas, May and early June temperatures and humidity conditions were likely to favor seed set. Seed production and seed set were at a maximum in late spring, generally low in midsummer, and improved to some extent in the fall.

Ergot was severe on Dallisgrass but seldom developed to a critical level before mid-June. Certain foliage diseases and sugarcane borers were severe under continuous seed production but were seldom a factor before mid-summer.

The response of Dallisgrass in the spring to nitrogen applied in late winter, favorable environmental conditions, and low incidence of diseases and insects resulted in highest seed yields and quality being obtained in late spring. Generally, low seed yields and quality in mid-summer, lack of response to applied fertilizers, and high incidence of diseases and insects suggest that Dallisgrass stands should be utilized for purposes other than seed production in the summer. Seed quality may improve in the fall, but neither yield nor quality is likely to be as good as in the spring.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Crops Research Division. TREFOIL PRODUCTION FOR PASTURE AND HAY. U.S. Dept. Agr. Farmers B. 219, 16 pp. 1963.

The perennial trefoils--birdsfoot, narrow-leaf, and big trefoil--are increasingly important pasture and hay legumes on a number of soil areas in the U.S.

The trefoils offer these advantages: (1) They produce well on soils less fertile than needed for alfalfa and on soils that are poorly drained or heavily textured, or that have high clay, saline, or alkaline content; (2) once established, they provide exceptionally long-lived permanent pasture for grazing and cover; (3) they make high-quality hay and silage; (4) they compare favorably in feeding value with other common legumes; (5) they persist during drought and grow well in midsummer; (6) they readily reseed and spread; (7) they do not cause bloat in cattle or sheep, even when grazed in pure stands; (8) they grow well on fertile soils in permanent pastures that are left down a long time and on land too rolling to cultivate or renovate; and (9) birdsfoot trefoil, the most widely grown of the trefoils, produces hay that compares well in protein value with alfalfa hay cut at like stages of growth.

Two factors have limited the use of the trefoils: (1) Satisfactory trefoil stands are hard to establish, compared with alfalfa, red clover, and other forages; and (2) trefoil seed is difficult to harvest.

Practices gradually overcoming these disadvantages include: (1) Band seeding or drilling over fertilizer for better stands and reduced seeding cost; (2) applying selective herbicides for control of weeds and weed grasses in trefoil fields; (3) defoliating or partly defoliating green trefoil plants with chemicals before direct combining of seed crop; and (4) mowing and drying trefoil in the swath for 8 to 24 hours before combining seed.

A culture and care publication on trefoil production for a pasture and hay was given.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Savage, E. F., Hayden, R. A., and Ward, W. E. REFERENCE ON PEACH VARIETIES. Ga. Agr. Expt. Sta. Mimeo. Ser. N. S. 158, 143 pp. 1963.

With a trend toward processing more of the Georgia peach crop and the development of new processed products, there has been some re-examination by growers and processors of the good and bad points of varieties developed many years ago.

The origin, parentage, and time of commercial introduction of selected varieties of peaches were given. The appearance of the fruit was described as it was grown under Georgia conditions. The vigor of the tree was indicated. The leaf gland type useful occasionally in identifying a variety was included.

Elberta is a midseason blooming variety, and all varieties in the reference were listed as blooming so many days before or so many days after Elberta. Varieties that bloom 3 to 4 days ahead of Elberta are usually quite susceptible to late spring frosts in this area.

Size and showiness of bloom were described to enable a grower to determine whether or not he has the variety desired.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

Zielinski, Q. B., Sistrunk, W. A., and Mellenthin, W. M. PEACH VARIETIES FOR OREGON. Oreg. Agr. Expt. Sta., Sta. B. 589, 30 pp. 1963.

A description and illustration of some of the principal peach varieties grown in Oregon were given for the commercial fruit grower.

Tables and photographs.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

Sullivan, D. T., and Enzie, J. V. GRAPE VARIETIES FOR NEW MEXICO. N. Mex. Agr. Expt. Sta. B. 475, 6 pp. 1963.

Grape production in New Mexico declined from nearly 3 million pounds in 1945 to only 0.5 million pounds in 1954. Among the reasons for this decline are the increase in the amount of winter injury, the prevalence of such pests as nematodes, and lime-induced chlorosis.

Many new varieties have been developed which may be better adapted to New Mexico climatic and soil conditions. The performance of 25 grape varieties adapted to the area were given.

N. Mex. State U., Agr. Expt. Sta., University Park, N. Mex.

Briggle, L. W., and Reitz, L. P. CLASSIFICATION OF TRITICUM SPECIES AND OF WHEAT VARIETIES GROWN IN THE UNITED STATES. U.S. Dept. Agr., Agr. Res. Serv. Tech. B. 1278, 135 pp. 1963.

The classification of Triticum species was given along with an illustrative and descriptive guide to the commercial varieties grown in the United States in 1959 that was not included in the original bulletin (Classifications of Wheat Varieties grown in the United States in 1949).

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Murphy, H. J., Goven, M. J., Schark, A. E., Blood, P. T., Kelley, W., and Jensen, R.
MAINE-NEW HAMPSHIRE-VERMONT POTATO VARIETY TRIALS FOR 1962. Maine
Agr. Expt. Sta. Misc. P. 657, 41 pp. 1963.

Cooperative variety trials were conducted to determine the field and storage behavior of selected potato varieties when grown under soil, climatic, and cultural conditions common to the major potato growing areas of Maine, New Hampshire, and Vermont.

Varieties included in these trials were grouped into four general categories: (1) New varieties from other potato growing areas that might be adapted to some segment of the Tri-State potato producing areas; (2) older standard varieties whose quality and growth characteristics have been well established and which serve for comparison or check varieties; and (3) numbered seedling varieties which were selected for trial on the basis of preliminary data from tests conducted by entomologists, pathologists, and plant breeders. The results of the trial were given.

Tables.

U. Maine, Maine Agr. Expt. Sta., Orono, Maine.

Woodlands

Limstrom, G. A. FOREST PLANTING PRACTICE IN THE CENTRAL STATES. Central
States Forest Expt. Sta. Misc. Release 34, 194 pp. 1962.

The latest available information on tree planting in the central hardwood region--where to plant, what to plant, and how to plant--was presented. It was prepared especially for people to whom landowners usually go when seeking advice on tree planting.

The material presented was aimed primarily at those interested in planting trees for timber production, erosion control, and watershed protection. Much of it applies equally well to planting windbreaks, shelterbelts, and Christmas trees, but the unique features of these specialty plantings were not treated.

The "Species Selection Guides" lists species recommended for planting on the various sites within the several states. The Guides were preceded by a discussion that answers such pertinent questions as where should trees be planted, how does site affect species selection, what ground preparation is necessary, and how should trees be planted?

Central States Forest Expt. Sta., FS, USDA, Columbus 15, Ohio.

Carlson, N. K., and Bryan, L. W. THE HONAUNAU FOREST: AN APPRAISAL AFTER
SEVEN YEARS OF PLANTING. J. Forestry 61:643-647. 1963.

The decadent condition of the 10,500 acres of the Honaunau Forest, situated on the west side of the island of Hawaii was described. This forest lies at elevations of 2,300 feet (average rainfall 105 inches per year--temperature 70^o F.) to 4,800 feet (average rainfall 48 inches per year--temperature 64^o F.). Soils are volcanic and mostly shallow.

During the past 7 years, 850 acres were cleared and planted at an average cost of \$38.72 per acre. The bulk of the area was planted to Hawaiian ash (Fraxinus uhdei) and Toon, Australian redcedar (Toona ciliata var. australis). Various eucalyptus species, Nepal alder, loblolly and slash pine, Queensland-maple, etc., were planted in small blocks. The

summary of growth showed ash at 3 years to be 1 to 29 feet high and Toon (Australian red-cedar) up to 42 feet high. The cutting cycle was judged to be 30 to 40 years with volumes of 30,000 to 50,000 bd. ft. per acre. Predicted returns, over the 7 percent capitalization, should be about \$900 per acre net.

Problems such as type of stand, clearing by machine or chemicals, and thinning call for long research. More pressing problems are tree selection for better growth, a cure for ash lodging and brooming, detailed soil analysis, mycorrhizal effects, and disease and insect control.

Forester, Bishop Estate, Kailau-Kona, Hawaii.

Kozlowski, T. T. GROWTH CHARACTERISTICS OF FOREST TREES. J. Forestry 61: 655-662. 1963.

The intermittent character of tree growth was reviewed. Different parts of trees grow at varying rates and at different times. Shoot growth of many Temperate Zone trees occupies a relatively short part of the frostfree season. Marked apical dominance in conifers was emphasized, with the amount of annual shoot elongation decreasing down the main axis and inward on branches of the main stem. Growth intermittency also was indicated by the production of lammas and proleptic shoots. There was considerable evidence that shoot growth of many species depended on stored foods rather than products of current photosynthesis. Often there was much better correlation of shoot growth with environment of the season of bud formation than with the season of bud expansion into a shoot. Cambial growth, which lasts longer than apical growth, also was basically intermittent. It varied with environmental change, at different stem heights, and around the tree bole. Intermittency in cambial growth was related to live crown ratios and degree of suppression. In suppressed trees, cambial growth in the lower bole may be negligible. Much of the observed variation in radial change in stems reflects hydration changes which were superimposed on cambial growth. Cambial growth initiation may be readily confused with rehydration of stems prior to beginning of cambial growth in the spring.

U. Wis., Madison, Wis.

Myers, C. A., and Martin, E. C. FIFTY YEARS' PROGRESS IN CONVERTING VIRGIN SOUTHWESTERN PONDEROSA PINE TO MANAGED STANDS. J. Forestry 61: 583-586. 1963.

Six plots on the Fort Valley Experimental Forest, Ariz., demonstrate how virgin southwestern ponderosa pine forests can be converted to managed stands. These areas were partially harvested twice, with emphasis usually on the removal of large, declining trees.

Board-foot increment decreased and cubic-foot increment increased during the period after initial harvest. On five plots, the number of trees less than 12 inches in diameter increased greatly, those 12 to 20 inches decreased, and the number of trees larger than 20 inches increased. On the sixth plot, with diameter distribution approximating a J-shaped curve, the number of trees increased in all diameter classes smaller than 21 inches.

Cutting transferred growth to trees of 1919 origin, most of which were too small to be measured in board feet. Growth of these young trees was usually slow because most of them were in dense groups. Some not in dense groups were contributing to board-foot ingrowth. Economic conditions at time of harvest made precommercial thinnings appear impractical for the Southwest.

The suggested conversion procedure for Virgin stands was:

1. Initial cuts should remove declining trees and, where necessary, reduce the density of young sawtimber groups.
2. Dense young stands should be thinned as soon as possible.
3. Nonstocked areas should be planted where satisfactory natural regeneration appears only at irregular intervals.
4. After the second or third partial harvest, conventional cutting systems producing many-aged or even-aged stands should be used. In some areas, systems leading to even-aged stands appear most practical.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Bennett, F. A. GROWTH AND YIELD OF SLASH PINE PLANTATIONS. U.S. Forest Serv. Res. Paper SE-1, 23 pp. 1963.

Height and diameter growth patterns of field- and forest-planted slash pine were illustrated. Yields as correlated with age, site, and stand density from three formal analyses were tabulated and discussed.

Charts and graphs.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

Gatherum, G. E., McComb, A. L., and Loomis, W. E. EFFECTS OF LIGHT AND SOIL MOISTURE ON FOREST TREE SEEDLING ESTABLISHMENT. Iowa Agr. and Home Econ. Expt. Sta. Res. B. 513: 776-792. 1963.

Forest tree seedling establishment problems common to stand conversion practices in Iowa were studied. The primary objectives were: (1) To determine the minimum treatment needed to insure successful survival and growth; (2) to study the relationships of light and soil moisture in plant competition resulting from stand conversion; and (3) to evaluate five species of conifers--European larch, Scotch pine, eastern white pine, Norway spruce, and red pine--for adaptability to region, site, and underplanting.

Field studies were made at the Brayton Forest in northeastern Iowa and consisted of: (1) Practical understory treatments to increase survival and growth of five underplanted conifers; and (2) controlled experiments to evaluate overstory and understory competition. Studies at the State Forest Nursery near Ames were planned to determine the relative growth and photosynthetic characteristics of three of the underplanted conifers (European larch, eastern white pine, and Norway spruce) and two shrubby hardwood species (dogwood and hazel) which offer serious understory competition in the forest.

The results of these studies led to the following conclusions: (1) An intensive cutting of the understory and overstory canopies was needed for maximum survival and growth of underplanted forest tree seedlings on the more fertile Iowa soils; (2) a gradual 2-year release of understory-overstory canopies, or the use of herbicides during the critical May-July growth period, or both, probably was necessary to prevent extreme competition from a released shrubby and herbaceous cover; (3) light saturation values ranged from 2,500 to 3,500 footcandles for all species, and near-maximum growth rates occurred at approximately 3,500 footcandles for all species except European larch; (4) drouth survival of forest

tree seedlings was increased with an increase in light intensity up to 3,000 footcandles; (5) European larch and eastern white pine were recommended for underplanting; (6) growth and photosynthetic efficiency of hazel and dogwood were sufficiently high to cause serious competition for all the conifers studied; (7) the photosynthetic compensation point can be used as an indicator of the tolerance and efficiency of some species; and (8) tolerance was a result of the adaptability of a species to competition for light, soil moisture, and nutrients.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa.

Benzie, J. W. CUTTING METHODS IN MIXED CONIFER SWAMPS, UPPER MICHIGAN. U.S. Forest Serv. Res. Paper LS-4, 24 pp. 1963.

Even-aged cutting methods (clearcut strips or blocks and shelterwood cuttings) and uneven-aged methods (diameter limit and tree selection) were studied at five separate locations in Upper Michigan. The most favorable results for regenerating mixed conifer swamps were obtained with complete removal of the overstory on small blocks or narrow strips. All cutting methods encouraged competition from broadleaf shrubs and trees, but partial cutting over the entire stand increased their abundance and size more than did clearcutting portions of the stand. Net growth during the first 5-year period was greatest in the uncut stands because of increased mortality in all partial cutting methods.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Roe, E. I. DIRECT SEEDING OF CONIFERS IN THE LAKE STATES: A REVIEW OF PAST TRIALS. U.S. Forest Serv. Res. Paper LS-3, 16 pp. 1963.

Since 1937, some 130 trials of direct seeding of conifers were made or reported in the Lake States and adjacent Canada, mostly on upland sites. Forty percent of the seedlings showed good results--one-half of them failed, and the remainder were only fair. Of the six species tested, jack pine was best. Results were favorable most often when the seed was sown broadcast or in spots on disked land or in fresh burns. Seed losses to birds and rodents and effects of competing vegetation were the most important causes of failure.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Briscoe, C. B. ROOTING CUTTINGS OF COTTONWOOD, WILLOW, AND SYCAMORE. J. Forestry 61: 51-53. 1963.

Cuttings of cottonwood, willow, and sycamore were collected monthly throughout the year and set in nursery beds.

Every species yielded an appreciable percentage of rooted cuttings every month. The best month was March; the worst month was June.

Willow rooted more cuttings than cottonwood or sycamore, and those which rooted grew faster. Cottonwood grew faster than sycamore.

Butt-cuts yielded more rooted cuttings than second-cuts, and those which rooted grew faster.

Shoots on cuttings with larger top diameters appeared to grow more rapidly, but only for butt-cuts of willow was the correlation statistically significant.

Inst. Trop. Forestry, FS, USDA, Rio Piedras, Puerto Rico.

The number of closed cones borne by representative jack pine trees in stands of different ages in northern Minnesota was counted, and the number of cones per acre was estimated. Sample lots of cones were then opened by drying, and germination was tested. The average numbers of total seeds and viable seeds per cone were then applied to the cone counts to give total and viable seed per acre. Stored-seed estimates were made for four 9- to 13-year-old plantations, two 40-year-old stands, and two 70- to 80-year-old stands. In addition, tests of viability were run on seed from cones borne by 130-, 186-, and 196-year-old trees.

In both the 40-year-old and 70- to 80-year stands, the number of cones produced increased with d.b.h.

The amount of viable seed stored in the cones varied from 226,000 per acre in the 40-year unthinned stand to 759,000 for thinned timber of this age. Intermediate were 70- to 80-year jack pine with 381,000 and the plantations with 477,000 per acre. This was a range of 1.7 to 5.8 pounds of germinable seed per acre.

The plantations bore appreciably fewer cones than any except the 40-year unmanaged timber. However, their greater yield of seed and its high germination made them second only to the thinned stand in viable seed supply. The greatest number of cones was borne by the 40-year-old thinning; this, plus its sizable number of viable seeds per cone resulted in its superior yield.

The 70- to 80-year-old stands showed much lower cone and seed production than similar timber that was 15 years younger.

Cones 8 or more years old in the 70- to 80-year old stands yielded less than half the seeds per cone, both total and viable, produced by younger cones.

Dead seeds were of no consequence in any of the other cone lots tested except in one from a 130-year old tree in which they amounted to 7 percent.

Jack pine produces viable seed to an age of almost 200 years and possibly longer. The number of viable seeds per cone, however, generally decreases with age. To some extent, this was paralleled by a reduction in the total number of seeds per cone and an increase in the proportion of empty seeds.

Jack pine seed from cones exposed to temperatures high enough to scorch them sometimes fail to germinate but at the same time appear to be viable. This suggests the possibility that high temperatures may sometimes induce dormancy in this normally nondormant seed.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Boyce, S. G., and Hosner, J. F. ALTERNATING STORAGE TEMPERATURES INCREASE THE GERMINATION OF YELLOW-POPLAR SEED. J. Forestry 61: 731-733. 1963.

Seed of yellow-poplar (*Liriodendron tulipifera* L.) normally require 2 years or more for complete germination. Storage of seed for 24 weeks at specified alternating temperatures results in germination of all viable seed. All viable seed stored alternate weeks at 36° and 54° F. or at 36° and 70° F. germinated either while still in storage or after being placed in flats in a greenhouse. When the temperature cycle was 36° and 70° F., germination began during the 13th week of storage and viable seed had germinated 10 weeks later. When the temperature cycle was 36° and 54° F., seed did not germinate during storage, but began germinating the fourth week after being placed in a greenhouse, and germination was completed five weeks later. Most viable seed held continuously at 20° F. and alternate weeks

at 20° and 36° F. were killed. Even some seed held alternate weeks at 25° and 54° F. were killed by freezing. For direct or nursery seeding, germination can be increased by storing yellow-poplar samaras alternate weeks at 36° and 54° F.

Central States Forest Expt. Sta., FS, USDA, Carbondale, Ill.

Winjum, J. K. EFFECTS OF LIFTING DATE AND STORAGE ON 2+0 DOUGLAS-FIR AND NOBLE FIR. J. Forestry 61: 648-654. 1963.

The effect of lifting date and cold storage on 2+0 planting stock were studied. Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco) and noble fir (Abies procera Rehd.) were lifted at 4-week intervals from October to May. Half of the stock was immediately outplanted and half was held for 4 weeks at 20° C. before planting.

Sample seedlings from each group were studied in the laboratory; the amount of carbohydrate in the needles was determined; and new roots were counted after 4 weeks in a controlled environment chamber held at springlike conditions. Survival of unstored stock for both species was 90 percent or better for most lifting dates; none was less than 70 percent. Stored seedlings of Douglas-fir had 98 percent survival when lifted between November and March; similarly, noble fir survival was 87 percent when lifted between October and February. Storage in spring reduced survival more severely than did storage in fall. Root development in the laboratory was low in both early fall and late spring. Stored seedlings produced fewer roots in the fall and spring than did unstored seedlings but at least as many as unstored plants produced during the winter. Of the carbohydrates studied, only nonreducing sugar content followed a definite trend--low in the fall, reaching a peak in February, and falling again in late spring.

Lifting date from October to April appeared to affect seeding mortality only moderately when stock was handled carefully. Maximum and minimum survival generally related to root development indicated that a better chance existed for seedling establishment when roots were active. Since nonreducing sugar content generally parallels survival and root development, it might be used as an index to favorable lifting dates.

Weyehauser Co., Forest Res. Cent. Centralia, Wash.

Newton, M. SOME HERBICIDE EFFECTS ON POTTED DOUGLAS-FIR AND PONDEROSA PINE SEEDLINGS. J. Forestry 61: 674-676. 1963.

Sensitivity of Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco) and ponderosa pine (Pinus ponderosa Laws.) seedlings to operational-type brush control treatments was tested with simulated aerial sprays on potted 2+0 seedlings. Treatments of 1 to 4 pounds per acre of several herbicides applied at 2-week intervals indicated that Douglas-fir might be expected to recover from applications used to kill brush in a 4-month period during spring and summer. Ponderosa pine was more severely damaged than Douglas-fir, but demonstrated its greatest resistance in late summer, and its greatest sensitivity in spring and early summer. Douglas-fir, while it suffered the greatest apparent damage during the period of most rapid growth, recovered most readily from the early-season treatments. The effects of late-season treatments were especially noticeable with Amitrol; all trees treated with 2,4,5-T made complete recovery by the end of the second growing season; 2,4,5-T amine and 4-(2,4,5-TB) ester caused no measurable damage at any time, indicating that selectivity for Douglas-fir may be brought about by manipulation of solvent and formulation as well as molecular configuration.

Oreg. State U., Corvallis, Oreg.

Leaphart, C. D. DWARFMISTLETOES: A SILVICULTURAL CHALLENGE. J. Forestry 61: 40-46. 1963.

Dwarfmistletoes are one of the most serious diseases in conifer stands of the western United States, but they can be controlled at certain periods in the rotation of a stand through silvicultural tools now available to forest managers. Important publications about dwarf-mistletoes were reviewed and their recommended control methods discussed. Steps to achieve adequate control programs were suggested. Research needed to improve existing guides and to start feasible control projects was described. Until someone devises other control methods that will produce results faster, silvicultural methods should be used to gain better total production.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Windbreaks

Woodruff, N. P., Fryrear, D. W., and Lyles, L. ENGINEERING SIMILITUDE AND MOMENTUM TRANSFER PRINCIPLES APPLIED TO SHELTERBELT STUDIES. Trans. ASAE 6(1): 41-47. 1963.

The following contributions were made in two areas pertaining to shelterbelt research and to field evaluation of shelterbelts: (1) Demonstrated that data obtained from models in a wind tunnel interpreted in accordance with accepted engineering similitude principles can be used to evaluate field shelterbelt effectiveness satisfactorily; and (2) provided a method whereby the drag and the resistance coefficients for field shelterbelts can be determined from vertical velocity profile measurements made at two locations, one windward and one leeward, of the shelterbelt. These contributions should be useful in reducing the amount of work necessary in future evaluations of the effectiveness of existing tree shelterbelts in the Great Plains.

SWCRD, ARS, USDA, Manhattan, Kans. 66504

Fruits and Nut Crops

Jaynes, R. A., and Graves, A. H. CONNECTICUT HYBRID CHESTNUTS AND THEIR CULTURE. Conn. Agr. Expt. Sta. B. 657, 29 pp. 1963.

Chestnut blight, one of the most catastrophic plant diseases known, virtually eliminated a major forest tree in the eastern United States within half a century. The American chestnut tree was lost as a timber producer and as a source of wildlife food. The development of blight-resistant hybrid chestnuts as a forest crop is still in the experimental stage. Blight-resistant trees for orchards, as a source of food for wildlife, and for home or yard plantings can now be propagated.

Nine promising hybrids were selected and described because of their blight resistance, superior form, and vigorous growth.

Presently these trees must be propagated vegetatively. Grafting has proved the most successful method to date, though efficient stooling techniques may be possible.

The culture and care of growing chestnuts were given.

Conn. Agr. Expt. Sta., New Haven, Conn.

Machines designed for harvesting fruit were adapted for fruit thinning of peaches (*Prunus persica* cv. Redhaven) and compared with accepted hand thinning practices. Fruit set was materially reduced by machine thinning; however, a non-uniform distribution of persisting fruits often resulted. The greatest amount of thinning occurred in the upper-interior and upper-periphery and the least in the lower-periphery of the tree.

Irregular distribution of persisting fruit was associated with type of fruiting wood rather than location on the tree. Long and willowy branches fruiting on the terminal portion were more difficult to thin than "firm" fruiting wood or wood low in vigor. The size distribution of persisting fruits were similar to the fruits removed.

The following suggestions were offered for efficient machine thinning:

1. Adapt trees for machine thinning by: (1) Establishing main scaffolds at least 2 feet aboveground; (2) pruning back "hanger" type fruiting wood; (3) removing low hanging branches to give an open view of the trunk and scaffolds; and (4) clearing out unnecessary wood which will interfere with claw attachment.
2. Insure a solid, even orchard floor if a boom type machine is used.
3. Use a guide man to direct attachment and evaluate degree of thinning accomplished. This man should be experienced in thinning.
4. Use care in making attachments.
5. Do not make attachment over pruning wounds, cankers, or other irregular area on scaffold.
6. Make attachment to scaffold as nearly perpendicular to boom as possible.
7. Close claw firmly to prevent slippage during shaking.
8. Use experienced and responsible operators.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Hough, W. S., and Hill, C. H. SOME FACTORS AFFECTING INSECTICIDAL EFFICIENCY. Va. Agr. Expt. Sta. Tech. B. 162, 30 pp. 1963.

In 1946, DDT became the principal insecticide used in Virginia orchards. An investigation of the performance of several leading formulations sold for orchard use in Virginia was undertaken at the Winchester Fruit Research Laboratory. Formulations of other orchard insecticides were included as they supplemented or replaced DDT, or were sufficiently promising to evaluate as replacements of current insecticides.

The principal results and experience in the biological assay of commercial and experimental dry formulations, using the codling moth and the red-banded leaf roller as test insects were:

1. Commercial 50 percent DDT wettable powders varied considerably in toxicity, but within recent years comparative tests indicated greater uniformity of toxic efficiency among the preparations sold.
2. The commercial formulations of 75 percent DDT wettable powder were more effective and more uniform in performance than 50 percent DDT wettable powders.
3. Average particle size of 75 percent DDT wettable powders was less than in 50 percent DDT wettable powders.
4. Average particle size of 7 commercial 50 percent DDT wettable powders was 3.38 microns.

5. In experimental 50 percent DDT wettable powders containing identical ingredients, reduction of average particle size from about 4 microns to near 2 microns improved effectiveness. Improvement was most marked in residual toxicity through 3 weeks following an application.
6. Wettable powders prepared from technical DDT of "flake" and powder grades and from fresh (wax-like) or aged (dry and brittle cakes) DDT were equally effective in toxic performance.
7. Toxicity of DDT wettable powders was influenced by the inert ingredients (surfactants and carriers or diluents) to the extent that particle size alone was not a consistent index to comparative toxic efficiency.
8. Toxicity of 50 percent DDT wettable powders made with 3 types of clay diluents (Attaclay, Pikes Peak 9T66, and Barden clay) did not consistently favor one type of diluent. Incorporating a small quantity of synthetic silicate (HiSil) in the formulations did not alter toxicity consistently.
9. Residual toxicity of 50 percent DDT wettable powder was improved by adding a small quantity of Guthion or Sevin wettable powder (4 oz. to 8 oz. of 25 percent Guthion, or 8 oz. of 50 percent Sevin per 100 gal.).
10. Commercial and experimental formulations of 50 percent TDE (DDD) wettable powders failed to give adequate control of larvae of the red-banded leaf roller. Reduction of average particle size from 3.2 to 2.4 microns in experimental formulations did not increase toxicity.
11. Fortifying TDE (DDD) wettable powder with 10 percent antiresistant compound resulted in little or no improvement of toxicity to red-banded leaf roller larvae.
12. The average particle size of 6 commercial wettable powder formulations of parathion varied from 2.2 microns to 11.9 microns. No consistent relationship was apparent between particle size and comparative toxicity within 5 days of an application.
13. Eight commercial malathion wettable powders ranged from 3.9 microns to 12.2 microns in average particle size. Although the formulation with smallest particle size exhibited the highest level of toxicity, particle size was not a reliable index to toxic performance of the other formulations.
14. Parathion and malathion residues acted as fumigants to weaken larvae that hatched from eggs placed near the fruit after apples were sprayed.
15. Five 50 percent Sevin wettable powders ranged in average particle size from 2.2 microns to 4.6 microns. Slight difference in toxicity was indicated among the formulations within 3 weeks following an application, although the 2 formulations with smallest particle size were usually more effective. Thereafter, decline of toxicity was most rapid in the formulation with largest particle size.
16. Rewetting initial deposits of wettable powder sprays to a point just short of run-off resulted in a slight dispersion of the particles and loss of toxicity.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Still, G. W., and Fahey, J. E. STUDIES OF INSECTICIDE RESIDUES ON GRAPES AND IN WINES. U.S. Dept. Agr., Agr. Res. Serv. ARS-33-81. 7 pp. 1963.

Three applications of lead arsenate to grapes after bloom resulted in excessive residues of lead and As_2O_3 on the grape berries at harvest. When grapes carrying excessive amounts of lead and As_2O_3 were made into wine, practically all the lead residue and about three-fourths of the arsenic were lost during the wine-making process. Much of the lost residue was accounted for in the pomace and lees (settlings of wine during aging.) Filtering the

wine did not remove either lead or arsenic residues. Slightly less arsenic occurred in wine processed by the cold-press method than in wine processed by the pulp-ferment method. The amounts of lead and arsenic did not exceed the tolerance for those materials in the finished wine.

Tests conducted in 1946, 1947, and 1950 showed that DDT residues on fresh grapes were largely dissipated in the wine-making process, regardless of whether the wine was made by the pulp-ferment or cold-press method. Practically all the DDT was accounted for in the pomace.

Wine made from grapes sprayed excessively with parathion and close to harvest contained no parathion or little more than a trace. These and similar results with grapes sprayed excessively with DDT indicate that residues of organic insecticides on grapes are unlikely to occur in the finished wine. Similar results were obtained in less extensive tests with grapes sprayed with EPN and methoxychlor.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

Cutright, C. R. INSECT AND MITE PESTS OF OHIO APPLES. Ohio Agr. Expt. Sta. Res. B. 930, 78 pp. 1963.

The insect and mite pests of Ohio apples were described and illustrated. The types of damage that each produces were given.

Since control measures are subject almost annually to changes, the bulletin did not deal with the methods or the economics of insect and mite suppression.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Powell, D., Meyer, R. H., and Owen, F. W. PEST CONTROL IN COMMERCIAL FRUIT PLANTINGS. Ill. Agr. Expt. Sta. C. 864, 52 pp. 1963.

The battle against insects, diseases, and other pests in Illinois orchards must be fought every year. To help in the fight, various experimental agencies are constantly working out better methods of pest control. The latest recommendations from the Illinois, Kentucky, and Indiana Experiment Stations, the Illinois Natural History Survey, and the U.S. Department of Agriculture were given.

Pest-control measures are so closely linked with other operations that they cannot be easily separated. The practices recommended for quality fruit--not just adequate pest control were given. For efficient operation, orchard practices must be well organized.

U. Ill., Col. Agr., Coop. Ext. Serv. Urbana, Ill.

Osburn, M. R., Pierce, W. C., Phillips, A. M., Cole, J. R., and Barnes, G. L. CONTROLLING INSECTS AND DISEASES OF THE PECAN. U. S. Dept. Agr., Agr. Hbk. 240, 52 pp. 1962.

Insects and diseases of the pecan were described and illustrated. Recommended control methods were given.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781

Field Crops

Demirlicakmak, A., Kaufmann, M. L., and Johnson, L. P. V. THE INFLUENCE OF SEED SIZE AND SEEDING RATE ON YIELD AND YIELD COMPONENTS OF BARLEY. *Canad. J. Plant Sci.* 43: 330-337. 1963.

Field experiments with three seed sizes and three seeding rates of three barley varieties were conducted in 1959-60 at Edmonton and Lacombe, Alberta, Canada. Data were obtained on emergence, culm counts, grain yields, and 1000-kernel weights.

Although there was no effect of seed size on emergence, the culm counts and yields were highest for large seed and lowest for small seed over all rates, varieties, and tests. The differences between yields from large and small seed decreased slightly as the seeding rate increased, but the seeding-rate X seed-size interaction was not statistically significant. There were varietal differences in yield response to seeding rates. Seeding rates in test plots should conform to those used in farming practice. The rate of seeding had a significant influence on 1000-kernel weights. The lowest rate produced the heaviest kernels and the highest rate produced the lightest kernels in each of four tests. Tillering capacity alone was a poor indicator of resulting yields. Further experiments, involving four seed categories of nine varieties in two tests, corroborated the above findings.

U. Alberta, Edmonton, Alberta, Canada.

Hancock, N. I., and Smith, E. L. LODGING IN SMALL GRAINS: INVESTIGATIONS ON CERTAIN CHARACTERS ASSOCIATED WITH LODGING IN SMALL GRAINS AND A NEW TECHNIQUE FOR MEASURING BREAKING STRENGTH OF STRAW. *Tenn. Agr. Expt. Sta. B.* 361, 26 pp. 1963.

The water content of small grain stems is relatively high at the soft-dough stage of maturity. The stems lose water rapidly between this stage and full maturity. Since resiliency of the stems is conditioned by water content, lodging evaluations based on resiliency are affected by the stage of maturity at which the measurements are made should be interpreted with caution.

The stems of small grain tillers taper from the lower-most internode to the internode subtending the head. Wheat stems, in general, do not taper as much as the stems of oats and barley. The component internodes of a small grain stem vary in length, weight, diameter, and wall thickness, depending upon their position in the stem. Observations on lodging have shown that stem breakage usually takes place in the third or fourth internode.

Nodding angles of the heads of lodging susceptible strains were appreciably larger than nodding angles of lodging-resistant strains.

A new technique for measuring the breaking strength of small grains culms was described that appears to be both rapid and accurate.

One break made in the middle of one internode per stem was sufficient in evaluating the breaking strength of one tiller. The third or fourth internode above the ground level should be the ones for breaking strength evaluation, since lodging appears to occur most frequently in these internodes.

The breaking strength of oats and wheat was more closely related with wall thickness than with culm diameter. This association was particularly striking for wheat. Breaking strength of barley internodes was more closely associated with culm diameter than with wall thickness, although the difference was not great. The product of values for wall thickness and diameter gave highest association with breaking strength.

Any technique of evaluating lodging resistance must be correlated with natural lodging. Breaking-strength values obtained from lodging-resistant strains were consistently higher than the values obtained from lodging-susceptible strains.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Mixon, A. C. EFFECT OF SEED SIZE ON VIGOR AND YIELD OF RUNNER PEANUTS. Auburn U. Agr. Expt. Sta., B. 346, 18 pp. 1963.

Experiments in the greenhouse at the Auburn Agricultural Experiment Station in 1958 and in the field at the Wiregrass Substation in 1959-61 were conducted to determine vigor and yield differences between peanut plants grown from various seed size classes in Alabama. The author concluded that:

1. Peanut seedlings grown from No. 1 seed emerged earlier and grew off faster than seedlings from small or medium "peg" seed. This greater vigor was evident throughout the season.
2. No. 1 seed resulted in higher pod yields than small "peg" seed in both 6-inch drilled plantings and in 50 pounds per acre plantings. Small and medium No. 1 seed produced 214 pounds per acre more than small "pegs" in spaced plantings and 194 pounds per acre more in drilled plantings. Two hundred fourteen pounds of pods at 11 cents per pound was valued at \$23.00. In 1961, the average increase of 387 pounds per acre of pods from small and medium No. 1 seed over small "pegs" was valued at \$42.00.
3. Only well-developed No. 1 peanut seed as recommended for planting in Alabama. Such seed favor rapid emergence, vigorous early growth, less difficulty in controlling weeds, and usually result in appreciably higher yields than smaller seed.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Shepherd, J. L. MECHANIZED PEANUT PRODUCTION: TILLAGE THROUGH HARVESTING AND CURING. Ga. Agr. Expt. Sta. Mimeo. Ser. N. S. 163, 27 pp. 1963.

Within the 1950-60 decade, virtually 100 percent mechanization was attained in the production and harvesting of the peanut crop in Georgia. The development of equipment, facilities, and techniques for combine harvesting and curing was followed by research and experimentation which have resulted in the following new and significant recommendations on procedure and equipment design for the more important phases of mechanized peanut production from tillage through harvesting and curing.

The recommendations constitute, in effect, a "package plan" of systematic procedure which introduces new approaches of very significant improvement over long-lived conventional practice. Greatest benefits will be obtained by carefully following the complete "plan" in detail.

Ga. Coastal Plain Expt. Sta., Tifton, Ga.

Harris, W. W., and Lawless, J. R. INTERRELATIONS BETWEEN POST-HARVEST DORMANCY AND SOIL MOISTURE IN GERMINATION OF WHEAT. Agron. J. 55: 340-343. 1963.

Results of field and laboratory germination tests indicate post-harvest dormancy of some wheat varieties may be responsible for erratic stands when early seeding is

practiced. Low soil moisture increased the detrimental effect of post-harvest dormancy by reducing number of seeds germinated as well as rate of seedling growth. Varieties differed in degree of post-harvest dormancy and in response to favorable or unfavorable soil moisture conditions. Good soil moisture at seeding time favored rapid germination and growth but both were severely restricted when seed did not have time to complete its dormant period before being planted.

Seeds had completed their dormant period if planting occurred at recommended time for the area (September 10-20) so that little benefit would be derived from using year-old seed then. Better stands should be obtained by using year-old seed, if early seeding is practiced.

Colby Agr. Expt. Sta., Colby, Kans.

Tingey, D. C. YIELD OF DRYLAND WINTER WHEAT TREATED WITH 2,4-D. Utah Agr. Expt. Sta., B. 441, 11 pp. 1963.

Results on the effect of 2,4-D on yields of winter wheat have been conspicuous for their lack of uniformity. Use of different varieties grown under different environmental conditions and the different interpretations by researchers on the actual stage of growth when treatments were made could contribute to the variable results.

2,4-D will control many weeds that appear in winter wheat, particularly if they are treated when small. Even though one obtains good weed control there is no assurance that the yields of wheat will be increased.

When 2,4-D was used according to the recommendations there usually was no reduction in the yield of wheat.

Where there are few weeds, which is usually the case in winter wheat, there is little to be gained in using 2,4-D. If there are numerous weeds in the wheat and they are about as far along as the wheat, then there is justification for using 2,4-D.

The amine form is much safer to use than an ester form of 2,4-D. The minimum dosage of the amine of 2,4-D is $\frac{3}{4}$ to 1 pound of the acid to the acre and of an ester from $\frac{1}{2}$ to $\frac{3}{4}$ pound of the 2,4-D acid to the acre. Higher rates will be required for larger weeds, and for those species that are more resistant. The 2,4-D should be applied in 5 to 10 gallons of water to the acre.

Applications should be made only in the spring when the wheat is in the tillering stage of growth.

Wheat fertilized with nitrogen or grown on soil high in nitrogen may be more susceptible to 2,4-D than wheat grown without nitrogen fertilizer or on soil low in nitrogen.

Fall planted wheat can be sprayed with 2,4-D in the early spring even though few tillers have developed. Weeds are more easily killed while they are small. Late spring emerging weed seedlings do not have much of a chance in competition with established fall wheat.

Utah State U., Agr. Expt. Sta., Logan, Utah.

Agricultural Engineering Research Division. DRYING EAR CORN BY MECHANICAL VENTILATION. U.S. Dept. Agr. Misc. P. 919, 20 pp. 1963.

Many of the hazards of harvesting and storing corn can be removed by adopting mechanical ventilation for drying ear corn in storage on the farm. Mechanical ventilation gives controlled drying and overcomes the problem of storing wet corn harvested with mechanical harvesters.

This modern method of drying is valuable as a means of handling a high-moisture crop on an emergency basis and as a part of regular crop management. It fits in well with modern production, harvesting, and handling methods.

With controlled-drying equipment, corn can be stored safely, marketed without a moisture discount, and saved in wet years. It can be harvested early to: (1) Take advantage of good harvesting weather; (2) reduce field losses from insects; (3) obtain cleaner husking; (4) lower harvesting costs; and (5) complete harvesting in time for fall plowing and seeding of wheat or cover crops.

Power for a drier may be provided by an electric motor or by a gasoline engine. Drying may be accomplished with heated air or with unheated air. With heated-air drying, corn can be dried in any kind of weather, and the short drying time permits repeated use of the equipment. Advantages of unheated-air drying are: (1) Little supervision required; (2) lower initial equipment cost; (3) no possibility of damage to grain from high-temperature air; and (4) no fire hazard.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

Scudder, W. T. EVALUATION OF HERBICIDES FOR SOYBEANS ON CENTRAL FLORIDA ORGANIC SOILS. Fla. Agr. Expt. Sta. Tech. B. 650, 36 pp. 1963.

During the years 1956-58, five screening trials were conducted on the organic soil at Zellwood, Florida, to evaluate 25 different selective herbicides, applied pre-emergence for weed control in soybeans. Out of these trials, four chemicals were selected for more detailed studies in advanced replicated trials. These were CDAA, CDEC, EPTC, and PCP. All of these gave excellent weed control without crop injury at rates considered satisfactory for the development of a practical treatment.

The discarded chemicals were eliminated for reasons such as poor weed control, crop injury, too great variability in activity, or combinations of these factors. The chemical rates required to give adequate weed control on this organic soil often were found to be higher than would be economically convenient or practical to use.

The advanced herbicide evaluation program included two replicated yield trials. The first was conducted during 1957 using three rates of each of three herbicides and three varieties. CDAA was applied at 6, 9, and 12 pounds per acre; EPTC at 5, 10, and 15 pounds per acre; and PCP at 10, 15, and 20 pounds per acre. All treatments gave excellent weed control without producing any significant injury to the crop. None of the treatments injured the soybeans sufficiently to cause a reduction in the bushels of beans produced.

A similar trial in the summer of 1958 tested CDEC in addition to the chemicals used during 1957. CDAA and CDEC at 4 and 6 pounds per acre and EPTC at 8 and 12 pounds all gave excellent weed control, in some cases surpassing that secured by hoeing and cultivating. With both 8 and 12 pounds of PCP, however, observed weed control, especially of grasses, was poorer than that obtained in the other treatment plots or the cultivated checks. The soybean plants tolerated all herbicide treatments used in this experiment without showing visible symptoms of chemical injury. Yields did not reflect any effects attributable to herbicide treatments.

EPTC applied as a surface spray gave excellent weed control without harming soybeans. Considering present costs for the rates required on organic soil, this chemical did not compete favorably with CDEC or CDAA. EPTC is not registered with the U.S. Department of Agriculture for use on soybeans.

CDAA and CDEC, gave excellent weed control at rates from 4 to 6 pounds per acre and were used safely on soybeans at 8 or more pounds. At the lower rates, CDAA was found to

be slightly more effective against grasses than CDEC. CDEC gave slightly superior control of broadleaf weeds than did CDAA. Both have been approved by the Food and Drug Administration and are registered by the U.S. Department of Agriculture for grower use on soybeans.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Keller, L. H. COSTS AND RETURNS FROM PRODUCING AND PROGRESSING SORGHUM SYRUP. Tenn. Agr. Expt. Sta. B. 363, 14 pp. 1963.

Data on the costs and returns for producing and processing sorghum syrup in Tennessee were given.

The following table summarizes most of the data.

Table. Estimated costs and returns per acre for sorghum syrup, by yields per acre, production and processing phase

Item	Yield in gallons per acre			
	75	95	125	150
Production costs:				
Fertilizer (300#/ac., 6-12-12)	\$8.25	\$8.25	\$8.25	\$8.25
Tractor (5.9 hr. @ \$1.04)	6.13	6.13	6.13	6.13
Other machines (disc, plows, cultivators, etc.)	4.25	4.25	4.25	4.25
Land charge	7.50	7.50	7.50	7.50
Total production costs	\$26.13	\$26.13	\$26.13	\$26.13
Processing costs:				
Annual equipment & building costs ¹				
Depreciation	\$3.52	\$3.52	\$3.52	\$3.52
Repairs	1.24	1.24	1.24	1.24
Capital charge	1.06	1.06	1.06	1.06
Fuel (butane gas)	11.80	14.96	19.68	23.61
Tractor use (juice extraction)	5.01	6.35	8.35	10.02
Total processing costs	\$22.63	\$27.13	\$33.85	\$39.45
Total average production and processing costs (excluding labor charge)	\$48.76	\$53.26	\$59.98	\$65.58
Returns:				
Gross value of syrup (\$1.97/gal.)	\$147.75	\$187.15	\$246.25	\$295.50
Less production and processing cost	48.76	53.26	59.98	65.58
Net returns to labor	98.99	133.89	186.27	229.92
Total labor required (hrs.)	104.2	110.8	120.7	129.0
Net returns per hour	.95	1.21	1.54	1.78

¹ Based on an average of 2,680 gallons processed per mill per year and an average yield of 95 gallons per acre, each mill processed, on the average, the sorghum produced on 28.2 acres in 1962.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Vegetable Crops

Brooke, D. L. LABOR AND MATERIAL REQUIREMENTS FOR VEGETABLE CROPS. Fla. Agr. Expt. Sta. B. 66, 83 pp. 1963.

Information by areas on the usual amount of labor required by operations, approximate dates of performance, and amounts of materials used in the production of vegetable crops was given. This information may be used to arrive at a suitable combination of crops or to indicate the aggregate size of a farm operation. While not a substitute for farm accounts, general estimates of the cost of production and harvesting of vegetable crops may be made by applying current rates to the respective quantities of labor and materials required.

Maps and tables.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Crop Reporting Board. COMMERCIAL VEGETABLES FOR FRESH MARKET AND PROCESSING: USUAL PLANTING AND HARVESTING DATES IN PRINCIPAL PRODUCING AREAS. U.S. Dept. Agr., Agr. Hbk. 251, 76 pp. 1963.

Information on usual planting and harvesting dates for fresh and processing vegetables was given. Twenty-seven principal fresh market vegetables and melons, 10 principal processing vegetables, mint for oil, and strawberries were included in this report. Data were shown only for the crops and States included in the regular program of estimates.

The same seasonal classifications were listed for the fresh market crops in each State as in the regular program of vegetable reports. Classifications were determined by the season, or period within the season, when the bulk of each crop is usually harvested.

Harvesting dates for most vegetables refer to the period when the crop is removed from the field. For crops which are left in the field to cure, harvesting dates refer to the time the crop is pulled, cut, or picked. Dates are not necessarily those of marketing or processing. For perishable crops, harvesting and marketing or processing periods are nearly identical, but for storage crops, such as cabbage and onions, the marketing season extends beyond the end of the harvest. In areas where production for processing is from acreage grown primarily for fresh market, harvesting for processing usually follows the harvest for fresh market.

Planting dates refer to the period during which seeding or transplanting is usually done. Dates shown do not take into account abnormal planting seasons caused by climatic or economic factors. The principal producing counties were grouped by geographic areas within States.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Campbell, J. A., Windham, S. L., and Thomas, W. O. TOMATO PRODUCTION FOR THE FRESH MARKET. Miss. Agr. Expt. Sta. B. 653, 19 pp. 1963.

A culture and care publication on tomato production for the fresh market was given. Miss. State U., Agr. Expt. Sta., State College, Miss.

Brown, L. D. CURING SWEET POTATOES--A FEASIBLE ON-FARM OPERATION. Mich. State U. Q. B. 45: 502-503. 1963.

Sweet potatoes can be cured satisfactorily without an elaborate curing chamber or temperature and relative humidity control devices, as long as the structure is reasonably

air tight and care is exercised to insure the availability of heat and moisture. Commercial growers willing to devote the minimal effort required to cure and store sweet potatoes for eventual sale on the fresh market should find it economically rewarding.

Samples of sweet potatoes grown at the Sodus Horticultural Experiment Station were subjected to two curing treatments after grading: (1) Cured for 10 days, commencing the day of harvest; and (2) maintained at atmospheric temperatures for 10 days and then cured for 10 days in the same manner as the first group.

The crates of sweet potatoes which were cured commencing the day of harvest averaged 91 percent marketable roots, and those subjected to the delay period before curing averaged 36 percent marketable roots.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Reid, J. T., and Brantley, B. B. MECHANICAL HARVESTERS FOR SOUTHERN PEAS. Ga. Agr. Expt. Sta. C. N. S. 36, 18 pp. 1963.

Four small and relatively inexpensive mechanical harvesters for Southern peas, each one utilizing a different principle of harvesting, were designed, constructed, and field tested in Georgia. The 1961 harvester is smaller and less expensive than the three previous models and is easily mounted on a medium-sized tractor. The machine has successfully completed 2 years of field trials with picking efficiencies ranging from 67 to 96 percent when harvesting peas which varied widely in their degree of maturity and desirable plant characteristics.

At the present time, no satisfactory cleaner has been incorporated into the harvester. The harvested material is a mixture of about 50 percent pods and 50 percent leaves and stems. In a commercial sheller, this mixture produced 19 percent clean shelled peas and the trash was not a problem in shelling. Shelled peas showed little damage and were acceptable to food processors. Work is now in progress to separate part of the trash in the field which will reduce the transportation cost and increase the capacity of the sheller.

The harvester was used successfully to harvest green lima beans.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION

Costs and Returns

Willsie, R. H. THE ECONOMICS OF CLASSIFYING FARMLAND BETWEEN ALTERNATIVE USES; WITH SPECIAL REFERENCE TO THE CROP-RANGE MARGIN IN KIMBALL COUNTY, NEBRASKA. Nebr. Agr. Expt. Sta. Res. B. 208, 48 pp. 1963.

At present, some farm programs are aimed at reducing the acreage of land used for crop production. These programs have the objectives of reducing quantities of certain farm commodities and conserving land resources. By shifting land from the production of certain farm commodities to other commodities or to grass, total farm income may be raised and the costs of farm price support and storage programs reduced.

The key to this land classification is the identification of soils on the break-even margin between alternative uses to which the land is suited. The break-even margin

between cultivated crops and range use was estimated for soils in Kimball County, Nebraska. The emphasis was on differences in soil productivity. The effect of locational differences on factor and product prices within the county were assumed to be negligible. Under present product prices and cost of production, wheat was the tilled crop yielding the highest return.

The economic criterion used for determination of best land use for given soils was the highest return to land. Estimated total returns were divided among land and nonland resources for wheat and range cattle production.

To compare wheat and range cattle returns, average prices for 1955-59 were used. Current costs were estimated. Costs varied between farms and between tracts within farms so a cost level 65 percent below average and the estimated average cost, were used in the comparisons. Forty-three soils were compared and classified by wheat yields into four classes.

At the highest cost level for both wheat and beef production, all soils compared returned more to land in wheat than beef production. With a low beef cost level, six soils in the lowest yield class were submarginal for wheat production. An average soil in the group yielding 6.3 to 8.4 bushels would become marginal for wheat production at a price of \$1.72. At a low wheat cost and high beef cost, the price of wheat would have to be reduced from \$1.76 to \$1.05 at the farm to make an average soil in the group yielding 6.3 to 8.4 bushels marginal as between wheat and grass. It was estimated that the group of soils with highest yields, 16.8 to 20.8 bushels, would become marginal at a price of about \$0.54 for wheat.

When the soil compared is being tilled, the cost of regrassing is an obstacle to shifting to beef. In making decisions relative to land presently tilled, returns to beef use must cover not only the amortized cost of regrassing but also the returns to wheat use. Only actual costs of reseeding the land to grass and the opportunity cost of wheat returns were considered in estimating the effects of regrassing costs on land use decisions in this study. These two cost factors alone, however, were found to be relatively large barriers to shifting cultivated cropland to range. Reseeding may pay if a 20 year or longer planning horizon is assumed, the land yields a low return in wheat, the reseeding cost is reduced by subsidy, or costs of production for range cattle are relatively low.

U. Nebr., Col. Agr., Agr. Expt. Sta., Lincoln, Nebr.

Soil Conserv. 28(11): 243-264. June 1963.

This issue of the Soil Conservation Magazine was devoted to conservation practices. The following articles were given:

- Sisk, L. LOUISIANA BANKERS TRAVEL FAR TO STUDY CONSERVATION. SCS, USDA, Spartanburg, S.C.
- Clay, J. E. CONSERVATION PLANTING PROTECT-BEAUTIFY ROADSIDES. SCS, USDA, Lafayette, Ind.
- Tegner, R. F. DUNE EROSION CONTROL--BATTLE AGAINST THE SEA. SCS, USDA, Berkeley, Calif.
- Campbell, F. W. NEW AERIAL PORTRAIT HELPS MAP BRIGHTER FUTURE FOR MAINE COUNTY. SCS, USDA, Orono, Maine.
- Richason, B. F., Jr. STUDENT GEOGRAPHERS-FARMERS STUDY CONSERVATION FROM THE AIR. Carroll Col., Waukesha, Wis.
- Jones, H. I. SOIL AND WATER CONSERVATION ALONG THE MAIN LINE. SCS, USDA, Denver, Colo.
- Smith, G. S. WATERSHED PROJECT BRINGS FLOOD-FREE HIGHWAY. SCS, USDA, Upper Darby, Pa.

Jones, H. I. DISTRICT OFFICER--COMMERCIAL PILOT--A PROFILE. No address given.

Nace, W. W. BY ACCIDENT AND BY DESIGN. SCS, USDA, Oakland, Md.

McBay, R. C. FROM WATERSHED DAM TO "COUNTRY CLUB". SCS, USDA, Van Alstyne, Tex.

Derr, L. E. SOIL SURVEYS HELP ENGINEERS BUILD BETTER ROADS AT LOWER COST. SCS, USDA, Stillwater, Okla.

Keller, G. A. AUDUBON CLASSES TRAVEL TO CONSERVATION-NATURE AREAS. SCS, USDA, Washington, D.C. 20250

Hole, E., and Vermeer, J. WHEAT GROWERS' MACHINERY COSTS, BY SIZE OF FARM, IN CENTRAL NORTH DAKOTA. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. 24, 21 pp. 1963.

Costs of owning and operating machinery on 3 sizes of spring wheat farms in central North Dakota in 1960 were given.

Three size groups were studied --(1) Group I, 55 farms with 180 to 419 acres of cropland; (2) Group II, 61 farms with 420 to 659 acres of cropland; and (3) Group III, 32 farms with 660 to 899 acres of cropland. Total cropland per farm for the 3 groups averaged 332, 535, and 776 acres, respectively.

Total cost per acre for major tractor-drawn and self-propelled machinery averaged about 15 percent higher on farms in group I than on farms in group III. Costs on farms in group II averaged only slightly higher than on those in group III.

The generally higher cost per acre of use on the farms in group I was influenced by several factors. The annual cost per implement was lower because the machines were older and somewhat smaller, but costs per acre were higher mainly because of lower annual use per machine. Operating time per acre was higher, both because the machines were smaller and because they were drawn through the fields at a slower rate.

The costs of using tractors, per hour of use, were higher on the larger farms. Ownership costs, such as depreciation and interest on investment, were higher because the tractors generally were newer and larger. Fewer hours of use annually per tractor on the larger farms also added to the higher cost per hour of use. Tractor costs averaged about 31 percent higher per hour of use on the farms in group III than on those in group I; they were 16 percent higher on farms in group II than on those in group I. If charges are added for drivers at a uniform rate per hour, costs per hour for tractor and driver were 9 and 17 percent higher on the farms in groups II and III, respectively, compared with the ones in group I.

The acreage covered per day averaged 30 percent greater on the farms in group III than on those in group I. The size of implements and acreage covered per day and per foot of width of implements were both 14 percent greater. On farms in group II, costs per acre of use were not appreciably different from those on group III.

MOS, USDA, Inform, Div., Washington, D. C. 20250

Lindsey, M. M. AN ECONOMIC ANALYSIS OF CUSTOM WORK ON FARMS IN THE YAZOO-MISSISSIPPI DELTA. Miss. Agr. Expt. Sta. B. 667, 15 pp. 1963.

Custom work in the agriculture of the Mississippi Delta has made most of its important growth in the last 10 years. Much of this rapid expansion of custom services has centered around the harvesting of soybeans that have been planted on cropland released by the acreage restrictions on cotton.

In 1959, over 93 percent of the farmers in the Delta area of Mississippi hired machine work done on their farms, with an average expenditure of \$1,067 per farm. Total custom work amounts to more than 18 million dollars annually in the area.

Prices charged for custom work in the Delta vary more because of differences in machine size and power source than area differentials. Other factors that affect the charges are completeness of the service offered, distance traveled, field and crop conditions, crop seasonality, weather conditions, and labor scarcity.

Farmers are concerned over the trend toward higher machinery investment and are investigating the possibilities of custom work as an alternative for certain jobs. A procedure for evaluating this alternative in specific farm situations was presented.

Some machinery dealers feel that the high cost of farm machinery and equipment is hurting sales, and will probably consider the newer practice of equipment rental if sales remain relatively slow.

Custom work is increasing in the Delta and will probably continue to expand if custom operators can adapt their services to the changing farm situation. Custom work has grown rapidly for certain crops and operations that compete for time and labor with the production and harvesting of cotton. Many custom operators intend to modify their service plans to fit the changing pattern of Delta agriculture.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Nelson, A. B., Kuhlman, L. R., Furr, R. D., Campbell, W. D., and Waller, G. R., Jr.

CREEP-FEEDING FALL CALVES. Okla. Agr. Expt. Sta. B. B-610, 11 pp. 1963.

Creep-feeding increased gains of fall calves from 50 to 100 pounds depending on the level of winter feeding, milk production, and age of the cow. Calves ate an average of 875 pounds of creep-feed. In most years, both creep-fed and non-creep-fed calves sold at the same price per 100 pounds, although the creep-fed calves were fleshier.

Creep-feeding a concentrate mixture only until green grass was available in the spring (late April or May) increased gains an average of 48 pounds. However, non-creep-fed calves tended to recover by gaining more until weaning. Creep-feed consumption to spring was 256 pounds per calf and the increased value of the calf was greater than the cost of the small amount of creep-feed.

Creep-feeding fall-dropped calves until spring, with either average quality alfalfa hay fed long or in pellets, proved to be the most profitable method studied. Calves consumed more pounds of the alfalfa pellets, but feed costs were higher due to the extra feed processing involved.

In one test, creep-feeding profitably increased the weaning weights of calves from first-calf heifers in a fall-calving system.

Okla. State U. Expt. Sta., Stillwater, Okla.

Hoefer, J. A., Pearson, A. M., Stevenson, J. W., and Luecke, R. W. EFFECT OF FIBROUS FEEDSTUFFS FED DURING THE FINISHING PERIOD ON GAIN, FEED EFFICIENCY AND CARCASS CHARACTERISTICS OF SWINE. Mich. State U. Q. B. 45: 480-490. 1963.

The consumer preference for leaner pork and the decline in demand for lard emphasizes the importance of reducing carcass fat in swine. The average market hog produced in the United States carries more fat than is desired by the consumer or consistent with optimum feed efficiency. Since the composition of the pig carcass is influenced by heredity and environment, it seems reasonable that controlled nutrition represents one possibility of immediately affecting the quality of pork carcasses produced.

Four high fiber feeds (corn and cob meal, wheat bran, oats, and alfalfa meal) were formulated as complete rations which were approximately equal in protein, fiber, and calculated TDN. The alfalfa meal ration was in pelleted form as well as meal. These experimental rations were fed to pigs from the time they reached an average of approximately 120 to 125 lb. until slaughter weight of 205 to 210 lb.

Wheat bran and the alfalfa rations were most effective in reducing the amount of fat on the carcass. Corn and cob meal also improved leanness whereas oats tended to produce carcasses similar to the controls. With wheat bran and alfalfa meal, the improvement in carcass quality was associated with reduced rate of gain, whereas, with the pelleted alfalfa meal and the corn and cob meal rations, the gain was depressed very little. Gross feed conversion favored the control ration but on the basis of TDN, the corn and cob meal and pelleted alfalfa rations were equally as efficient as the high energy control.

Gilts gained more slowly than barrows but were significantly superior in producing carcasses with a higher percent of lean cuts, less back fat, and a larger loin eye.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Poli, A. LONG-TERM PRODUCTION PROSPECTS FOR WESTERN AGRICULTURE. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. No. 33, 39 pp. 1963.

Crop production in the West has increased steadily over the years. The same major productive factors that stimulated national agricultural output has stimulated that in the West, but irrigation has played a more significant role in the West.

Index numbers of total crop production, crop production per acre, and cropland harvested in the West since 1940 and projected to 1975 show that: (1) Substantial increases in total crop production have occurred during the past 20 years and that further increases can be expected; (2) expansion of total cropland acreage will not be as important a factor in increasing future production as it has been in the past; and (3) increased yields per acre by increased irrigation and improvement in other productive factors have been and will continue to be dominant in stimulating agricultural output.

Cropland acreage in the West is expected to increase only about 3 percent by 1975, but irrigated cropland will expand by 18 percent. A little more than half of this new irrigated acreage will be cropland now dry-farmed; the remainder, newly developed raw land.

Nonforested grassland will increase by almost 600,000 acres by 1975. Six of the 11 Western States will increase their grassland area by 2,235,000 acres.

Roughly a third of the 4.4 million acres of newly irrigated land which will come into production between 1959 and 1975 will be capable of growing a wide variety of crops. The crop patterns on this land will be flexible, permitting land to be shifted from one crop to another in accordance with future local and national needs.

Per-acre yields of most western crops and crop groups are following national trends and can be expected to increase materially between now and 1975. Per-acre yields of all but 8 of the 84 major crops grown in the West will probably increase by 1975. Average crop yields per acre over the entire West are expected to increase 25 percent by 1975. Under unusually favorable conditions, an increase of a little more than 50 percent could be attained. Projected crop yield estimates for 1975 are slightly higher for the Mountain region than for the Pacific region.

Total crop production should expand at a faster rate during the 15-year period from 1960 to 1975 than it did during the 20-year period from 1940 to 1960. The index of total crop production rose 38 points from 1940 to 1960, but from 1960 to 1975 it is estimated that it will increase another 43 points.

Expected increases in yields and in total crop production were attributed largely to: (1) Expansion of irrigated acreage; (2) improved farming methods; (3) more efficient and effective use of irrigation water; (4) increased and more efficient use of fertilizer; (5) development of improved plant varieties; and (6) more efficient use of improved weed and insect sprays and chemicals.

By 1975, all pasture and rangeland in the West is expected to increase its productive capacity about 80 percent over what it was in 1950. Range specialists estimate that carrying capacity of pasture and rangeland in the Pacific region will increase almost 140 percent over what it was in 1950; and in the Mountain region, from 50 to 60 percent. Clearing of trees and brush, removing other undesirable plants, insect and rodent control, reseeding, fertilizing, rotation grazing and seasonal management of pasture, and adding moisture to the land in various ways are some of the measures which will be used to increase carrying capacity.

By 1975, the overall crop pattern of the West may differ somewhat from that of 1959 because local and national demands for farm commodities will probably change as our population continues to increase, keeps moving toward the West, and changes some of its other characteristics. The West will continue to increase its production of popular high-value crops to meet this changing demand.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Institutional, Educational, and Social Factors Affecting Conservation Application

Tompkin, J. R., and Sharples, J. A. THE ROLE OF OPERATORS' EXPECTATIONS IN FARM ADJUSTMENT. Ohio Agr. Expt. Sta. Res. B. 936, 32 pp. 1963.

Data on the operators' expectations in farm adjustment were obtained by interviewing farmers in nine west-central Ohio counties during the 1955-60 period. Information was obtained each year from thirty-five 160-acre operators and thirty-five 320-acre operators. The general findings indicate that the sample operators' preproduction expectations of product prices and crop yields did not conform closely to the prices and yields realized during the year. Operators' expectations of acreages to be planted to each crop and numbers of livestock to be sold were consistent with actual acreages planted and numbers actually sold.

The sample operators did not appear to rely heavily on any particular price-data series in making production price predictions for the coming year. They did recognize seasonal price patterns in their predictions. Irregular field size, temporary rotation changes, and going into or out of acreage allotment were the main reasons given by operators for crop acreage changes from the preceding year. The operators attributed differences between expected and actual crop yields primarily to weather conditions. Most operators explained differences between expected and actual product prices as due to their own error in predicting total national production. Some operators blamed inferior quality of product. Operators tended to base their yield and livestock birth rate expectations for the coming year on their past years' experience.

Investigation of the effects of various nonprice factors on operators' decisions suggested that nonprice influences may be more important than moderate product price changes in causing farmers to adjust, or not adjust, production.

Maps, tables and graphs.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Staff Writer. AGRICULTURE SPURS NATION'S GROWTH BY RAISING OUTPUT WHILE
 RELEASING MANPOWER TO INDUSTRY, U.S. AGRICULTURE SET THE STANDARD
 FOR A PROGRESSIVE ECONOMY. The Farm Index, II (1): 5-8. 1963.

In a modern society, one test of whether a Nation's economy is growing fast enough is its capacity to produce all the food and fiber it needs and at the same time release workers and physical resources from agriculture to produce industrial goods and services. By this test, U.S. agriculture is an outstanding success.

Year by year U.S. agriculture plays a smaller relative part in our growing economy. Yet the faster agriculture declines the more it contributes to the Nation's growth.

Agriculture has made the following specific contributions of major importance to the Nation's economic growth since the turn of the century: (1) Its release of workers is a direct contribution to industry as well as an indicator of overall economic growth; it has lowered food costs relative to incomes; (3) increased its purchases of industrial goods; (4) sustained output during economic depressions; (5) met wartime demands for food; (6) brought in high earnings from exports; and (7) assisted other countries in their economic development programs.

AMERICANS SPEND SMALLER SHARE
 OF INCOME ON FOOD

Year	Total income	Total food expenditures excluding alcoholic beverages	
		Amount	Per cent of total income
	Million dollars	Million dollars	Per cent
1960	351.8	70,195	19.95
1955	274.4	59,242	21.59
1950	207.7	47,448	22.84
1945	150.4	34,116	22.68
1940	76.1	16,740	22.00
1935	58.3	13,632	23.38
1930	74.4	17,964	24.15

MOS, USDA, Inform. Div., Washington, D.C. 20250

Soil Conserv. 28(7): 147-168. Feb. 1963.

This issue of the Soil Conservation Magazine was devoted to Conservation Progress. The following articles were given:

Williams, D. A. THE TRUE MEASURE OF CONSERVATION PROGRESS. SCS, USDA, Washington, D.C. 20250

Packer, R. J. CONSERVATION GROUND-WATER CONTROL RESCUES COUNTY ROAD--FARMLAND. SCS, USDA, Hysham, Mont.

Stennett, H. E., Mattern, P. G., Jr., and Fuller, G. C. BIRDSFOOT TREFOIL CONSERVATION DISCOVERY. SCS, USDA, Wellsville, N.Y.

McConnell, V. P. SIGNS OF CONSERVATION PROGRESS. SCS, USDA, Idaho Falls, Idaho.

Slaton, C. CONSERVATION PROGRESS STIRS PENNSYLVANIANS' MEMORIES. SCS, USDA, Harrisburg, Pa.

Smith, W. L. NEW WAY TO FERTILIZE GRASS ON NEW DAMS. SCS, USDA, Denton, Tex.

Brown, R. L. HAWAII'S OPERATORS BACK CONSERVATION WITH DOLLARS. SCS, USDA, Honolulu, Hawaii.

Bellard, C. F. RICELAND SMOOTHING--UNDER WATER. SCS, USDA, Alexandria, La.

Davis, L. W. THE DEAN OF TENNESSEE DISTRICTS--A PROFILE. No address given.

Metz, R. C. COMMUNITY WATERSHED PROJECT BRINGS MANY BENEFITS. SCS, USDA, Manhattan, Kans.

Green, E. C. CONSERVATION PAYS OFF FOR OREGON RANCHER. SCS, USDA, Silver Lake, Oreg.

Senterfitt, J. H., and Van Arsdall, H. E. "SOD-BUSTING" THE CONSERVATION WAY. SCS, USDA, West Palm Beach, Fla.

Oliver, W. B. ALASKA--LAST CONSERVATION FRONTIER. SCS, USDA, Palmer, Alaska.

Herbert, F. W. CONSERVATION NEEDS INVENTORY GUIDE TO PLANNING. SCS, USDA, Berkeley, Calif.

Woods, W. F. ADAPTABILITY OF CORPORATE ORGANIZATION TO FAMILY FARMS. Auburn U. Agr. Expt. Sta., B. 343, 37 pp. 1963.

Three forms of business organization are available to the family farm--the sole proprietorship; the partnership; and the corporation. The sole proprietorship has been the predominate and simplest form of organization in American agriculture. Special problems in resource accumulation and intergeneration property transfer have prevailed under the sole proprietorship. The corporate structure as an alternative solution to these and other problems was studied.

Observations of actual farm conditions disclosed that the corporate structure was a desirable form of business organization. However, problems of accumulation and transfer were solvable under the sole proprietorship and the partnership. The act of adopting any one of the three business organization forms did not assure problem solution. The differences concern the ease and business-like basis by which objectives may be accomplished under the corporate structure.

In decision-making, observations and analysis of the corporate structure and the alternatives to it relative to the problems of the individual farm are required.

Incorporating may have much to offer individual family farms, but it should not be viewed as the solution to all contemporary maladjustments in American agriculture. Adoption of the corporate structure offers possible solution to serious organizational problems through minor modifications of family farm organization.

Corporate farming does not signify the end of the traditional family farm. Rather, it may be a major tool for maintaining and increasing efficiency of the family farm unit.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

This issue of the Soil Conservation Magazine was devoted to farm recreation and contains the following articles:

- Partain, L. E. RECREATION BRINGS NEW OPPORTUNITIES TO RURAL AMERICA. SCS, USDA, Washington, D.C. 20250.
- Davis, D. O. TEXAS WATERSHED PROJECT YIELDS BONUS IN FUN-LANDOWNERS' INCOME. SCS, USDA, Milwaukee, Wis.
- Davison, V. E. DOVES AND PEACHES--DOUBLE LAND USE. SCS, USDA, Athens, Ga.
- Myrick, S. RECREATIONAL SITES NEAR HOMEKEY PHASE OF CONSERVING SOIL-WATER-HUMAN RESOURCES. Macon Telegraph, Macon, Ga.
- Merrill, F. WILDLIFE CONSERVATION FARM DEVELOPED FOR CITY VISITORS. SCS, USDA, Canfield, Ohio.
- Cross, J., and Colvin, J. WATERSHED LAKES BRING BENEFITS GALORE TO LOUISIANA'S CYPRESS BAYOU AREA. SCS, USDA, Alexandria, La.
- Neu, A. WINDBREAKS CUT EROSION--ARE BOON TO WILDLIFE. SCS, USDA, Jerome, Idaho.
- Sartain, L. P. TOWN CONSERVATION COMMISSION IS NEW RESOURCE IMPROVEMENT TOOL. SCS, USDA, Amherst, Mass.
- Hoit, R. N. PROFIT AND FUN IN RECREATION FARMING. SCS, USDA, Auburn, Ala.
- Allen, W. S. KIDS' RANCH CAMP OUTPAYS FARMING. SCS, USDA, Spartanburg, S.C.
- Archer, S. G. WATERSHED RESERVOIRS DRAW PAYING CUSTOMERS. SCS, USDA, Spartanburg, S.C.
- Bennett, J. S. NEW HOPE FOR URBAN AREA WILDLIFE. SCS, USDA, Columbus, Ohio.
- Fleming, R. MISSISSIPPI FARMERS CASH IN ON RECREATION. SCS, USDA, Jackson, Miss.
- Baker, J. A. USDA MOVES AHEAD ON RECREATION. Rural Development and Conserv., USDA, Washington, D.C. 20250

Davis, J. M. FARM VACATIONS IN EAST CENTRAL OHIO--DEVELOPMENT, PROFITS, AND PROBLEMS. U.S. Dept. Agr., Econ. Res. Serv., ERS-113, 16 pp. 1963.

Providing nonfarm families with opportunities to vacation on farms can help farmers supplement their incomes. This fact was apparent from an analysis of farms providing vacation facilities in five east-central Ohio counties.

Interviews with farm owners disclosed that--(1) Successful farm vacation enterprises were started with no additional capital investment in the farm and with space available for as few as two guests; (2) farm families enjoyed getting to know people who had different backgrounds, ideas, and ways of living; (3) business generally was slow during the first year but increased markedly during the second or third year; and (4) annual net income from these enterprises ranged from \$150 to \$1,500 for families who had provided farm vacation facilities for 2 years or longer.

Questionnaires completed in 1960 by 45 respondents representing 164 persons who vacationed in 2 of the 5 counties indicated that most chose a farm vacation for one or more of the following reasons: (1) To experience peace, quiet, and restfulness; (2) to get away from the city and its noise, crowds, rush, and traffic; (3) to enjoy outdoor life, see country scenes, and watch farm life--especially farm animals; and (4) to obtain a new vacation experience.

Interviews with representatives of four local farm vacation associations and the State association disclosed that guests of the Ohio farm families were from cities and towns in many different States. A few were from foreign countries.

More families used these facilities than did individuals traveling alone. Occupations of heads of these families were principally in professional, sales, office, managerial, skilled, or technical categories.

Farm vacation businesses can be developed rapidly in areas where several farm families provide such facilities. By working together each operator: (1) Benefits from the management experiences of others; (2) pays less for advertising, which is done on a group basis; and (3) may send extra guests to neighbors who have space available, receiving in turn, guests referred by neighbors when they receive more requests for reservations than they can accommodate.

To be successful in supplementing income through farm vacations, farm operators might well consider: (1) Encouraging such developments by several families in the neighborhood; (2) establishing local and State farm vacation associations, or joining a national group aiding and publicizing farm vacations; (3) making full use of advice and assistance of available public employees; and (4) obtaining available written information about such pertinent things as quantity cooking, work simplification, farm pond construction, and farm beautification.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Rush, J. D., and Botts, R. R. LIABILITY AND INSURANCE PROTECTION FOR FARMERS WHO HAVE INCOME-PRODUCING RECREATIONAL FACILITIES. U.S. Dept. Agr., Econ. Res. Serv., ERS-120, 6 pp. 1963.

As a source of side income, some farmers near cities are providing recreational facilities for the use of fee-paying guests. Additional liability is involved. The ordinary personal liability or "farmowner's" policy does not cover these income-producing recreational facilities. It covers only the basic farm operation. A farmer needs additional insurance on the side activities.

The liability involved in operating such recreational facilities and the type of insurance needed to provide financial protection against lawsuits arising from their use by fee-paying guests were discussed.

MOS, USDA, Inform. Div., Washington, D.C. 20250

Soil Conserv. 28(10): 219-240. May 1963.

This issue of the Soil Conservation Magazine was devoted to Soil Stewardship. The following articles were given:

Monk, M. S., Jr. CONSERVATION DISTRICTS WATCH SOIL STEWARDSHIP WEEK GROW. Pres. Natl. Assoc. of Soil and Water Districts, Batchelor, La.

Griffin, R. K. COLORADO RANCHER PROFITS BY COMBINING BUSINESS METHODS AND SOIL STEWARDSHIP. SCS, USDA, Colorado Springs, Colo.

Boggs, C. D. CONSERVATION HELPS CHURCHES AND SCHOOLS. SCS, USDA, Conway, S.C.

Jenkins, T. A., and Shotwell, W. C. MISSOURI'S CONSERVATION PRIEST IS MAN OF MANY WORKS-AND TITLES TO MATCH. SCS, USDA, Denver, Colo.

Turner, S. L. HE PRACTICES CONSERVATION IN "PARTNERSHIP WITH GOD". SCS, USDA, New Philadelphia, Ohio.

Allen, W. S. MINISTERS SPREAD STEWARDSHIP MESSAGE AS CONSERVATION DISTRICT CHAPLAINS. SCS, USDA, Spartanburg, S.C.

Lewis, D. H. SOIL STEWARDSHIP ON THE JOB. SCS, USDA, Goldendale, Wash.
Norman, T. JEWISH FARMERS' SOIL STEWARDSHIP INTEREST HAS BEEN
INHERITED FROM ANCIENT TIMES. Jewish Agr. Soc., New York, N.Y.
Buie, T. S. GOOD SOIL STEWARDSHIP KEY TO FULLEST LAND AND WATER
RESOURCE USE. SCS, USDA, Columbia, S.C.
Briscoe, S. THIS FAMILY FARM IS BASED ON CONSERVATION. Off. Inform.,
Washington, D.C. 20250
Jacobsen, R. A. FARM WIFE FINDS CONSERVATION FARMING REWARDING.
Ross-Bee Acres, Iron, Minn.
Bradshaw, J., and Yourchik, N. MORMONS SOIL-WATER STEWARDS FOR MORE
THAN A CENTURY. SCS, USDA, Salt Lake City, Utah.

Hannah, H. W., and Krausz, N. G. P. LAW FOR THE ILLINOIS FARMER. Ill. Agr. Expt.
Sta. C. 860, 85 pp. 1963.

Some of the laws that concern the farm people and those in related business in Illinois were given.

The information given will not enable anyone to act as his own lawyer. The purpose of the circular is to give its readers two kinds of help: (1) Information concerning their rights and responsibilities; and (2) a better realization of situations that may contain legal dangers. Knowing when a situation is dangerous or likely to become so will enable a farmer to consult a lawyer in time to settle issues that could lead to costly and long-drawn-out disputes.

U. Ill., Col. Agr., Coop. Ext. Serv., Urbana, Ill.

BIOLOGY

Fish

Isaac, G. W., and Bond, C. E. STANDING CROPS OF FISH IN OREGON FARM PONDS.
Trans. Amer. Fisheries Soc. 92: 25-29. 1963.

Standing crops of fish in representative Oregon farm ponds were estimated by marking and recapture or by draining and enumeration. Most of the ponds were in the Willamette Valley, but a few were in central and southern Oregon. The average standing crop of bluegills (Lepomis macrochirus) was about 130 pounds per acre. The average standing crop largemouth bass (Micropterus salmoides) for 12 ponds was 104 pounds per acre. Central Oregon ponds appeared to support more pounds of bass per acre than western Oregon ponds.

Rough-skinned newts (Taricha granulosa granulosa) were present in large numbers in some Willamette Valley ponds, with standing crops up to 245 pounds per acre. This species is believed to be an important competitor for food in fish ponds.

Rayonier Inc., Olympic Res. Div., Shelton, Wash.

Mandal, L. N. EFFECT OF SALINITY ON THE TRANSFORMATION OF NITROGEN IN THE
BRACKISH WATER FISH FARM SOILS. J. Indian Soc. Soil Sci. 10: 255-261. 1962.

The effect of different levels of salinity in water on the transformation of nitrogen, both native as well as added in the form of fertilizers, in the brackish water fish farm soil

was investigated in the laboratory. Two fertilizers--ammonium sulphate and urea and five levels of salinity--0, 10, 20, 30, and 40 parts per thousand, were used. There was one check series (no fertilizer). The surface water and the soil were analysed periodically, the former for NH_3 and NO_3+NO_2 nitrogen and the latter for exchangeable and NO_3+NO_2 nitrogen. Total nitrogen was determined at the end of the experiment.

In the check series, the available nitrogen content (NH_3+NO_3) in the surface water increased with the increase of salinity and reached the maximum value at 20 parts per thousand. The exchangeable nitrogen content in the soil on the other hand showed a decrease at the first stage of increasing salinity and on reaching the minimum at 20 parts per thousand began to increase with further rise of salinity. Inference was drawn that the floating organisms which derive nutrients from the water phase only would have a better environment for growth in the salinity range of 10 to 20 parts per thousand, whereas for those algae growing in contact with soil surface, salinities higher than 20 parts per thousand were favourable.

In the fertilizer treated series, increased salinities were found to be beneficial as they maintained all along a higher amount of available nitrogen than in the control (no salinity). The increased salinities were also very effective in reducing the loss of nitrogen from the added fertilizers. In the higher salinity treatments, greater amount of nitrogen was held in the soil complex and the nitrification rate was also lower.

Central Inland Fisheries Res. Inst., Barrackpore, West Bengal, India.

Kiser, R. W., Donaldson, J. R., and Olson, P. R. THE EFFECT OF ROTENONE ON ZOOPLANKTON POPULATIONS IN FRESHWATER LAKES. Trans. Amer. Fisheries Soc. 92: 17-24. 1963.

Though the use of rotenone is a common procedure in freshwater fishery management, little is known of its effect on zooplankton. Fern Lake, a shallow dystrophic lake in western Washington, was treated with 0.5 p.p.m. of 5 percent rotenone powder in June 1960. Biweekly sampling of the open water, shore edge, and marsh area prior to and for 6 months following treatment provided quantitative measurements of zooplankton populations. Open-water species were completely removed, and remained absent for over 3 months. Organisms along the shore edge resisted the effect of rotenone, but eventually disappeared for several weeks. Those species inhabiting the dense weed patches did not all succumb to rotenone. The rare appearance of large numbers of males and usually early ephippial-egg-bearing female Cladocera were observed.

Silver Lake, another shallow, dystrophic lake, was treated with 1 p.p.m. of rotenone in September 1960, and an immediate effect on the zooplankton populations was observed. The rotenone penetrated to the thermocline at the 30-foot depth in the first 6 hours, killing Cladocera and Copepoda as it sank.

A most significant observation for fishery management was the length of time that zooplankton, organisms important as fish food, were absent from the lake. Preapplication zooplankton populations were not established until several months after the lakes had become nontoxic to fish and has been restocked.

Centralia Col., Centralia, Wash.

Hughes, J. S., and Davis, J. T. VARIATIONS IN TOXICITY TO BLUEGILL SUNFISH OF PHENOXY HERBICIDES. Weeds 11: 50-52. 1963.

The toxicity to bluegill sunfish (Lepomis macrochirus, Rafinesque) of different commercial formulations of 2,4-D, 2,4,5-T, 2,4-DP, and silvex was determined. The variations

among formulations of the same herbicide were much greater than those among different herbicides. Variations in toxicity of a single formulation were also noted. Formulations of each herbicide were reported as either safe or unsafe for equatic applications. Amine salts were generally less toxic to fish than esters. The formulation selected for use should be assayed prior to field application, using the receiving water.

La. Wildlife & Fisheries Comm., Monroe, La.

Upland Wildlife

Anderson, W. L., and Compton, L. V. MORE WILDLIFE THROUGH SOIL AND WATER CONSERVATION. U.S. Dept. Agr., Soil Conserv. Serv. Agr. Inform. B. 175, 14 pp. Rev. 1963.

An illustrative and descriptive guide on the use of soil and water conservation practices to increase wildlife was given.

SCS, USDA, Inform. Div., Washington, D.C. 20250

Dasmann, R. F., and Dasmann, W. P. MULE DEER IN RELATION TO A CLIMATIC GRADIENT. J. Wildlife Mangt. 27: 196-202. 1963.

A comparison of mule deer (Odocoileus hemionus) populations and their habitats occurring along a climatic gradient from humid coastal forest through chaparral to sagebrush reveals differences in soils, quality of forage, plant successional rate, and animal numbers. These differences determine the usefulness of fire, mechanical treatment, or other disturbance of climax vegetation for improving deer habitat. They also affect the degree of control which must be exercised over big game numbers.

The protein content of deer forage tends to follow the climatic gradient. In general, soils of the more humid vegetation regions produce less protein and hence support fewer, and smaller, deer in permanent populations than do the soils of less humid regions. Although protein content of deer forage can be increased by burning in these humid regions, the increase is only temporary. Fire, logging, or other means of removing climax vegetation and starting successional growth favor deer in the coastal forest and chaparral by increasing the amount and the protein content of forage. In the arid sagebrush, such disturbances are usually detrimental.

The high value of timber in most of the coastal forest prohibits direct management for deer, and deer are a temporary crop following logging. Chaparral and sagebrush, however, can be managed for the production of deer as a primary crop.

U. Calif., Berkeley, Calif.

Pengelly, W. L. TIMBERLANDS AND DEER IN THE NORTHERN ROCKIES. J. Forestry 61: 734-740. 1963.

Since 1880, fires and logging have altered the general aspect of large portions of the virgin coniferous forests of the northern Rockies to a diverse admixture of timber remnants, second growth timber reproduction, pole stands, and brushfields of varying sizes. The seral shrubs in the forest understory and clearings in many areas are important as winter range for white-tailed deer and mule deer. Logging is the most effective and least

expensive habitat management tool at the disposition of the game manager. The current disparity between the apparent economic values of the timber resource and the indefinite value of game, however, will preclude logging specifically to aid game for some time to come.

Temporary increases of good deer forage are produced on Douglas-fir--ponderosa pine sites about 10 to 15 years after logging and then it gradually declines, with poor forage shrubs and tree reproduction gaining dominance in the understory composition. Current extensive cutting to control insect damage on grand fir sites has limited potential for improving white-tailed deer winter ranges due to a less favorable seral succession and the rigid habitat requirements of this deer.

Deer are subject to heavy periodic winter mortality on the marginal, heavy snowfall ranges where seasonal availability of forage is equally as important as species composition and volume. Cutting alone cannot produce good winter ranges where terrain is unsuited to deer.

Excessive timber operations in any one area tend to produce too many roads which increase hunter access to the detriment of quality hunting. Other factors to consider are upsets in numbers and distribution of game animals following the profound ecological impact of large cuttings and fires, with the possibility of depredations on adjacent timber reproduction.

Experimental habitat manipulation by logging, controlled fires, thinnings, and herbicidal sprays was recommended.

Wildlife Ext., Montana State U., Missoula, Mont.

Gamble, H. B., and Bartoo, R. A. COMPARISON OF TIMBER AND WILDLIFE VALUES AND RETURNS ON FARM WOODLOTS. J. Forestry 61: 741-746. 1963.

For the average size farm in Sullivan County, Pa., net cash timber returns, based on a cruise of the woodlots on 18 farms, varied from \$477 per year for those farmers doing their own cutting and skidding to \$310 per year for those farmers selling on the stump. Returns from wildlife varied from a high of \$257 for those rooming and boarding hunters to a low of \$26 per year for those charging a hunting fee of one dollar per hunter per day. Leasing of the hunting rights returned about \$42 per year.

Returns to the county as a whole from deer hunter expenditures totaled approximately \$473,200 per year. Five percent of this, or about \$23,800, was received by landowners producing the game. A \$200 deer and hunter damage cost per farm per year stimulated an increase in gross revenue to the county of about \$546 per farm, or \$47.70 per deer. Timber harvested under reasonable cutting practices returned to farmers a gross of about \$5.25 per acre per year. The returns to the community as a whole from deer under total forest conditions averaged approximately 95 cents per acre per year. If the returns from all other forms of wildlife were added to the returns from deer, it was estimated that total wildlife returns to the community as a whole would be approximately one-quarter those of timber.

In Sullivan County private landowners have little economic justification for making expenditures toward the improvement of wildlife habitat. Resource allocation to privately owned forest land should be directed toward the production of timber rather than of wildlife, if the primary objective of the owner is profit maximization.

Pa. State U., University Park, Pa.

Heidmann, L. J. DEER REPELLENTS ARE EFFECTIVE ON PONDEROSA PINE IN THE SOUTHWEST. J. Forestry 61: 53-54. 1963.

Browsing by Rocky Mountain mule deer kills many young ponderosa pines and keeps others in a hedge-like stage indefinitely. As trees browsed for many years usually have extensive root systems, they can grow out of reach of deer rapidly if protected from browsing. Two repellents, TMTD and ZAC, applied to the trees at the beginning of the growing season reduced browsing from 56 percent to 9 percent (TMTD) and 8 percent (ZAC). Protection did not last into a second growing season.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Flagstaff, Ariz.

Wetland Wildlife

Miller, R. J., and Reber, F. R. FARM POND SURVEY: WILDLIFE TO SPARE. Wis. Conserv. B. 27(4): 20-21. 1963.

The SCS sent questionnaires to 400 southwestern and south central Wisconsin land-owners who have 413 farm ponds asking about the use of farm ponds by wildlife. Information was obtained from 117 owners. Soil conservationists contributed additional information.

Farmers build ponds for many reasons. Wildlife is usually considered an extra benefit or by-product. Their primary purpose is to retard floodwater, to reduce soil erosion damage, or to provide livestock water.

An amazing variety of wildlife uses ponds and pond areas. It provides hunting and fishing for many people and gives many others a chance to observe and study birds and animals.

While only 3 percent of the ponds were built specifically for wildlife, actually 40 percent were deep enough and large enough for fish stocking. Thirty-eight percent were stocked.

Of ponds stocked with fish, one-third had been stocked by federal hatcheries following examination and approval by State fish managers. Most of these have produced excellent results. The remaining two-thirds were stocked by the land-owners or naturally with wild fish populations.

Stocking with hook-and-line caught fish was usually unsatisfactory. Such fish are usually adults of unknown breeding potential. They are likely to be introduced in such numbers or mixtures as to cause an early upset of population balance. Hook-and-line caught fish are often introduced after their breeding season has passed, causing a year's delay. Identification is frequently erroneous, thus leading to introduction of undesirable fish.

Landowners reported that nearly every kind of game or fur animal occurring in their localities used their ponds or pond areas. Ponds too shallow for fish were used by ducks, muskrats, and many other animals.

Ducks used 78 percent of the ponds, 28 percent for nesting. Successful nesting ducks and broods were seen on 17 percent.

During the fall season, 49 percent of the ponds attracted enough ducks to provide fair to good hunting. An additional 30 percent of the ponds attracted enough ducks to provide occasional hunting.

Farmers reported seeing 65 successful broods which produced 444 ducklings, an average of 6.8 per brood. The average per pond was 3.2 broods or about 22 young for ponds which produced ducks. The survey area included a large amount of hilly, unglaciated land not noted for duck production. Nearly all ponds in the survey area have a fence around them to protect the fill and shoreline from grazing. Some pond owners have improved this fenced area for wildlife by planting trees and shrubs. Even those pond areas not fenced and planted

provide some area suitable for wildlife. Both semi-aquatic and upland animals used them. Farmers reported 31 percent of the ponds and pond areas were used by geese, 30 percent by pheasants, 27 percent by quail, and 35 percent by doves. Deer used 51 percent, raccoons 54 percent, and muskrats 24 percent. The farmers also mentioned songbirds, ruffed grouse, rabbits, woodchucks, foxes, herons, and many others.

Many pond owners mentioned other outdoor recreation although this information was not requested. Skating, swimming, picnicking, and boating were reported.

The farm ponds are doing a good job of floodwater and erosion control. The ponds in the survey area averaged 1.39 acres based on 71 ponds constructed recently. Their temporary storage capacity for floodwater control averaged 4.2 acre-feet. So they impounded an average of 2,400 acre-feet of floodwater, protecting much valuable cropland, roads, and other property. Stockwater was provided to permit better management of pastures. Soil erosion was reduced.

A pond area can be among the most valuable acres on the farm. With good planning, its value can be increased even more, especially for wildlife and recreation.

SCS, USDA, Madison, Wis.

Blackburn, R. D. EVALUATING HERBICIDES AGAINST AQUATIC WEEDS. Weeds 11: 21-24. 1963.

Techniques were developed for evaluating herbicides on submersed, floating, and emersed aquatic weeds. Among 75 herbicides evaluated on three species of submersed weeds only 1:1'-ethylene-2:2'-dipyridylum (diquat); 1:1'-dimethyl-4:4'-dipyridylum (paraquat); di-N,N-dimethylcocoamine salt of 3,6-endoxohexahydrophthalic acid (endothal); and acrylaldehyde (acrolein) gave 85 percent or better control at 1 p.p.m.w. in still-water tests. Only acrolein and the di-N,N-dimethylcocoamine salt of endothal were effective on submersed weeds at 1 p.p.m.w. in the limited-exposure test. The evaluation of 17 herbicides on three species of floating aquatic weeds indicated that diquat was effective when applied at rates of 1 or 2 lb./A. The tertiary fatty acid amines of 2,4-dichlorophenoxyacetic acid (2,4-D) were more effective on floating weeds than an ester of 2,4-D. Many of the 78 herbicides evaluated on alligator-weed (Alternanthera philoxeroides (Mart.) Griseb.) killed the tops, but only two retarded the sprouting of underwater nodes longer than 6 weeks. Applications of 20 lb./A. of 2-(2,4,5-trichlorophenoxy)-propionic acid (silvex) in two formulations retarded sprouting of underwater nodes for 8 weeks.

CRD, ARS, USDA, Fort Lauderdale, Fla.

SUPPLEMENT

Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

Scudder, W. T. PERSISTENCE OF SIMAZINE IN FLORIDA MINERAL AND ORGANIC SOILS. Fla. Agr. Expt. Sta. Tech. B. 657, 23 pp. 1963.

The activity of simazine persisting in two Florida soils was studied over the period from 1957-60 using corn, cabbage, oats, and several other triazine-sensitive indicator crops. In order to determine the rate of dissipation of this residual activity, 1, 2, 4, 8, and

16 pounds per acre of simazine were applied initially to Leon fs, and 2, 4, 8, 16, and 32 pounds per acre were applied to Everglades mucky peat. Activity loss and build-up were also studied using both annual and semiannual applications of 1, 2, and 4 pounds per acre of simazine on the sand and 2, 4, and 6 pounds on the peat. Crop plantings were made twice each year. Crops and weeds were rated for stand and development, and fresh plant weights were recorded for several of the plantings to determine the chemical activity as reflected by plant response.

The authors concluded that:

1. Sweet corn on both soils was injured by 8 or more pounds of simazine during the first crop season after application. Definite injury to corn attributed to simazine residues was restricted to the organic soil and occurred only during the second season 6 months after treatment.
2. Cabbage on sand grew normally after 6 months where 1 and 2 pounds of simazine were applied, after 1 year where rates up to 8 pounds were applied, and after 2 years where 16 pounds were used. On peat 6 months after treatment, cabbage showed no significant visible evidence of simazine activity from application rates up to 16 pounds per acre. After 1½ years, cabbage in the 32-pound organic soil plots no longer showed toxicity.
3. The first time oats were planted during the fall of 1958, they grew without evidence of injury in all plots, except those freshly treated. This included simazine treatments on mineral soil ranging from 1 to 16 pounds per acre incorporated 1 year earlier and up to 4 pounds sprayed 6 months before. On organic soil there was no activity against oats from treatments as high as 32 pounds incorporated 18 months before and up to 6 pounds sprayed 6 months before.
4. Activity indices for simazine were computed by combining the responses of all sensitive plants, including the weeds. These revealed that: (1) In fine sand soil, 1 pound per acre was completely inactivated during the first crop season (within 6 months); 2, 4, and 8 pounds affected crops for two seasons (1 year); and 16 pounds showed activity against five successive crops (2½ years). And (2) in peat soil, 2 and 4 pounds showed significant effect for only two seasons (1 year), and 8, 16, and 32 pounds lasted three seasons (1½ years).
5. Zero activity indices at the conclusion of the experiments indicated that there were no accumulations of toxic simazine residues in the soil from either annual or semi-annual spray treatments at rates up to 4 pounds per acre for 3 years on the mineral soil or 6 pounds per acre for 3½ years on the organic soil. The year-around warm and humid climatic conditions in Florida may be responsible for the more rapid depletion of residual simazine activity from both of these soils in comparison with other in cooler or drier climates.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Ashton, F. M. FATE OF AMITROLE IN SOIL. Weeds. 11: 167-169. 1963.

A laboratory study of the fate of amitrole-5-C¹⁴ in Yolo sl was conducted to assist in the intelligent use of this herbicide for crops. Time series were run and included the determination of evolved C¹⁴O₂ and other metabolic products in both sterile and unsterile soil; as well as a nonmetabolic chemical reaction product.

Amitrole was rapidly and extensively degraded by microbiological activity. The major metabolic product formed from amitrole was carbon dioxide. There were at least 13 additional compounds formed. One or more biologically produced compounds were tenaciously bound to the soil and appeared to be resistant to degradation.

Amitrole formed a complex with nickel, cobalt, and copper ions, but did not appear to do so with magnesium, manganese, ferric, or ferrous ions.

Amitrole underwent only minor modification in sterile soil.

U. Calif., Davis, Calif.

Wheeler, E. Y., Linn, E. R., and Pakula, A. C. EFFECT OF PRESERVATIVES ON FENCE POSTS IN OKLAHOMA. Okla. Agr. Expt. Sta. B. B-604, 15 pp. 1963.

In 1951, studies were initiated to determine the feasibility of preservative treatment to increase service life of posts made from native timber in Oklahoma. A 5 percent solution of pentachlorophenol in No. 2 fuel oil was used as a preservative because of its toxicity, low viscosity, and resistance to leaching. The cold-soak preservative process was utilized due to simplicity and low plant investment. Untreated posts of each species were used as controls.

After 4 to 10½ years of observation, no deterioration was noted in properly treated posts. In one group of treated black willow posts, which had an erratic preservative retention rate, some failed and others showed signs of deterioration. All other treated posts remained in good condition.

Untreated control posts in all species except black locust failed completely or demonstrate advanced deterioration due to decay and insects.

The service life of blackjack oak, eastern cottonwood, black willow, post oak, green ash, bitternut hickory, American elm, hackberry and western soapberry was greatly extended by soaking the posts in a 5 percent solution of pentachlorophenol in No. 2 fuel oil.

Okla. State U. Expt. Sta., Stillwater, Okla.

Radioactive Fallout

Romney, E. M., Lindberg, R. G., Hawthorne, H. A., Bystrom, B. G., and Larson, K. H. CONTAMINATION OF PLANT FOLIAGE WITH RADIOACTIVE FALLOUT. Ecology 44: 343-349. 1963.

Studies on the contamination of plant foliage by radioactive fallout originating from nuclear detonations at the Nevada Test Site were conducted during the 1955 and 1957 weapons-testing series.

Fallout particles intercepted by plant foliage were principally of sizes smaller than 44μ diameter. The foliage of most forage plants selectively trapped these small-sized particles in the matted hairs and crevices and on resinous glands of the leaf surface. The varying capacities for retaining fallout particles largely depended upon the mechanical-trapping characteristics of leaf surface.

Within distances downwind from detonation corresponding to 12 hours fallout time-of-arrival (less than 250 miles), there was good correlation between the beta activity of smaller than 44 μ diameter fallout particles deposited at the sampling site. The size of fallout particles generally decreased at greater distance downwind from detonation causing an increase in the percentage of fallout lodged on plant foliage.

Fallout particles lodged on plant foliage could not be completely removed; however, the radioactive contamination could be reduced to less than one-half by washing in mild detergents and chelating agents. Wind action effectively reduced the level of contamination initially deposited on plant foliage.

The solubility of fallout lodged on plant foliage from tower-supported detonations varied from 5 to 35 percent in 0.1 N HCl as compared to 60 to 90 percent for fallout from balloon-supported detonations.

The major contributors to the beta activity in the smaller than 44 μ diameter fallout particles at 90 days after detonation were radioisotopes of cerium, yttrium, and zirconium which, together, contributed about 60 percent. Radiostrontium accounted for nearly 5 percent of the beta activity and radiocesium contributed less than 1 percent.

U. Calif., Los Angeles, Calif.

Miller, J. R., and Reitemeier, R. F. THE LEACHING OF RADIOSTRONTIUM AND RADIOCESIUM THROUGH SOILS. Soil Sci. Soc. Amer. Proc. 27: 141-144. 1963.

Sr-90 and Cs-137 are hazardous, long-lived, nuclear fission products. Experiments were conducted in the greenhouse to determine their downward movement in soils under intensive leaching. The five soils (Norfolk, Hagerstown, Miami, Fort Collins, and Huntley series) selected for the investigation represented a wide range of soil properties, and the leaching treatments consisted of 30 inches and 300 inches of deionized water, 0.005N NaCl, and 0.005N CaCl₂. There was little downward movement of Cs-134 when the soils received the applications of deionized water, NaCl, or CaCl₂. Radioactive assays of the soil columns showed that 96.6 to 100 percent of the Cs-134 was in the surface two layers of the soil columns (average depth 1.4 inches) after 300 inches of leaching. In the leaching experiment with Sr, the CaCl₂ produced the greatest movement of Sr-89 and deionized water the least. The maximum distance Sr-89 penetrated into the soils when leached with 30 inches of water was 1.3 inches, and with 300 inches of water the distance was 4.3 inches. In general, there was more movement of Sr-89 in the Norfolk soil and least in the Huntley, with the other soils being intermediate.

SWCRD, ARS, USDA, Beltsville, Md. 20705

Coleman, N. T., Craig, D., and Lewis, R. J. ION-EXCHANGE REACTIONS OF CESIUM. Soil Sci. Soc. Amer. Proc. 27: 287-289. 1963.

Because Cs-137 is one of the abundant and long-lived fission products, there is growing interest in the chemistry of Cs in soils and clays.

Column leaching experiments with 0.001N CsCl with 1N KCl or CaCl₂ showed Cs sorption by a number of clays to be much larger from Ca than from K solutions. The sorption affinity of Cs relative to the complementary ion corresponded with that found by others for the Cs-K ion pair, but in Cs-Ca systems the Cs was sorbed to a larger extent than would have been expected from the results of experiments where Cs-Ca ratios in the equilibrium solution were not so small.

While all except a very small proportion of the sorbed Cs was displaced on leaching with 1N KCl, some 36 times as much remained after leaching with equal volumes of 1N CaCl₂.

Vermiculite sorbed very large amounts of Cs (about 1/3 of exchange capacity) from 0.001N CsCl-1N CaCl₂. The sorbed Cs was largely "fixed" against exchange with 1N CaCl₂. This suggests that Cs contained in interlayer spaces of vermiculite results in interplanar distances which will admit K but not Ca.

U. Calif., Riverside, Calif.

